

REGISTER

OF

THE LEHIGH UNIVERSITY,

1895-1896.

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SOUTH BETHLEHEM, PA.

1896.



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FOUNDED BY ASA PACKER.

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BETHLEHEM, PA.:  
TIMES PUBLISHING COMPANY.  
1896.

# TABULAR ALMANAC.

1895.	1896.	1897.
<b>JULY.</b>	<b>JANUARY.</b>	<b>JULY.</b>
S M T W T F S	S M T W T F S	S M T W T F S
... 1 2 3 4 5 6	... ... 1 2 3 4	... ... 1 2 3 4
7 8 9 10 11 12 13	5 6 7 8 9 10 11	5 6 7 8 9 10 11
14 15 16 17 18 19 20	12 13 14 15 16 17 18	12 13 14 15 16 17 18
21 22 23 24 25 26 27	19 20 21 22 23 24 25	19 20 21 22 23 24 25
28 29 30 31 ... ..	26 27 28 29 30 31 ...	26 27 28 29 30 31 ...
... ..	... ..	... ..
<b>AUGUST.</b>	<b>FEBRUARY.</b>	<b>AUGUST.</b>
S M T W T F S	S M T W T F S	S M T W T F S
... ... 1 2 3	... ... 1	... 1 2 3 4 5 6
4 5 6 7 8 9 10	2 3 4 5 6 7 8	7 8 9 10 11 12 13
11 12 13 14 15 16 17	9 10 11 12 13 14 15	14 15 16 17 18 19 20
18 19 20 21 22 23 24	16 17 18 19 20 21 22	21 22 23 24 25 26 27
25 26 27 28 29 30 31	23 24 25 26 27 28 29	28 ... ..
... ..	30 31 ... ..	31 ... ..
<b>SEPTEMBER.</b>	<b>MARCH.</b>	<b>SEPTEMBER.</b>
S M T W T F S	S M T W T F S	S M T W T F S
1 2 3 4 5 6 7	1 2 3 4 5 6 7	... 1 2 3 4 5
8 9 10 11 12 13 14	8 9 10 11 12 13 14	6 7 8 9 10 11 12
15 16 17 18 19 20 21	15 16 17 18 19 20 21	13 14 15 16 17 18 19
22 23 24 25 26 27 28	22 23 24 25 26 27 28	20 21 22 23 24 25 26
29 30 ... ..	29 30 31 ... ..	27 28 29 30 ... ..
... ..	... ..	... ..
<b>OCTOBER.</b>	<b>APRIL.</b>	<b>OCTOBER.</b>
S M T W T F S	S M T W T F S	S M T W T F S
... 1 2 3 4 5	... ... 1 2 3 4	... ... 1 2 3
6 7 8 9 10 11 12	5 6 7 8 9 10 11	4 5 6 7 8 9 10
13 14 15 16 17 18 19	12 13 14 15 16 17 18	11 12 13 14 15 16 17
20 21 22 23 24 25 26	19 20 21 22 23 24 25	18 19 20 21 22 23 24
27 28 29 30 31 ... ..	26 27 28 29 30 ... ..	25 26 27 28 29 30 ...
... ..	... ..	... ..
<b>NOVEMBER.</b>	<b>MAY.</b>	<b>NOVEMBER.</b>
S M T W T F S	S M T W T F S	S M T W T F S
... ... 1 2	... ... 1 2	1 2 3 4 5 6 7
3 4 5 6 7 8 9	3 4 5 6 7 8 9	8 9 10 11 12 13 14
10 11 12 13 14 15 16	10 11 12 13 14 15 16	15 16 17 18 19 20 21
17 18 19 20 21 22 23	17 18 19 20 21 22 23	22 23 24 25 26 27 28
24 25 26 27 28 29 30	24 25 26 27 28 29 30	29 30 ... ..
... ..	31 ... ..	... ..
<b>DECEMBER.</b>	<b>JUNE.</b>	<b>DECEMBER.</b>
S M T W T F S	S M T W T F S	S M T W T F S
1 2 3 4 5 6 7	... 1 2 3 4 5 6	... 1 2 3 4 5
8 9 10 11 12 13 14	7 8 9 10 11 12 13	6 7 8 9 10 11 12
15 16 17 18 19 20 21	14 15 16 17 18 19 20	13 14 15 16 17 18 19
22 23 24 25 26 27 28	21 22 23 24 25 26 27	20 21 22 23 24 25 26
29 30 31 ... ..	28 29 30 ... ..	27 28 29 30 ... ..
... ..	... ..	... ..



## CALENDAR.

1895.		1895-1896.	
Sept. 7, 9, 10,	Saturday, Monday,	(Examinations for Admis-	
	and Tuesday,	sion.	
Sept. 11,	Wednesday,	First Term begins.	
Oct. 10,	Thursday,	Founder's Day.	
Nov. 28,	Thursday,	Thanksgiving Day.	
Dec. 18,	Wednesday,	First Term ends.	
1896.		1896-1897.	
Jan. 6, 7, 8,	Monday, Tuesday,	(Examinations for Admis-	
	and Wednesday,	sion to Second Term.	
Jan. 8,	Wednesday,	Second Term begins.	
Jan. 18,	Saturday,	Junior Prize Orations due.	
Feb. 19,	Wednesday,	Ash Wednesday.	
Feb. 22,	Saturday,	Washington's Birthday.	
April 2,	Thursday,	Easter Holidays begin.	
April 7,	Tuesday, 8 $\frac{1}{4}$ A.M.	Easter Holidays end.	
May 25,	Monday,	(University Day Orations	
		due.	
May 27,	Wednesday,	Theses of Seniors due.	
May 27,	Wednesday,	(Senior Examinations be-	
		gin.	
June 8,	Monday,	(Annual Examinations	
		begin.	
June 14,	Sunday,	Baccalaureate Sermon.	
June 15,	Monday,	Class Day.	
June 17,	Wednesday,	University Day.	
Jun. 18, 19, 20,	Thursday, Friday,	(Examinations for Admis-	
	and Saturday,	sion.	
1896.		1896-1897.	
Sept. 19, 21, 22,	Saturday, Monday,	(Examinations for Admis-	
	and Tuesday,	sion.	
Sept. 23,	Wednesday,	First Term begins.	
Oct. 8,	Thursday,	Founder's Day.	
Nov. 26,	Thursday,	Thanksgiving Day.	
Dec. 23,	Wednesday,	(Christmas Holidays	
		begin.	
1897.			
Jan. 4,	Monday, 8 $\frac{1}{4}$ A.M.	Christmas Holidays end.	
Jan. 29,	Friday,	First Term ends.	
Feb. 1, 2, 3,	Monday, Tuesday,	(Examinations for Admis-	
	and Wednesday,	sion to Second Term.	
Feb. 4,	Thursday,	Second Term begins.	
June 16,	Wednesday,	University Day.	

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## THE LEHIGH UNIVERSITY.

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### ORIGIN.

The HON. ASA PACKER, of Mauch Chunk, during the year 1865, appropriated the sum of \$500,000, to which he added one hundred and fifteen acres of land in South Bethlehem, to establish an educational institution in the rich and beautiful Valley of the Lehigh. On this foundation rose THE LEHIGH UNIVERSITY, incorporated by the Legislature of Pennsylvania in 1866. In addition to these gifts, made during his lifetime, Judge Packer by his last will secured to the University an endowment of \$1,500,000, and to the University Library one of \$500,000.

### DESIGN.

The original object of Judge Packer was to afford the young men of the Lehigh Valley a complete education, technical, literary, and scientific, for those professions represented in the development of the peculiar resources of the surrounding region. In furtherance of this purpose instruction is liberally provided in Civil, Mechanical, Mining, and Electrical Engineering, Chemistry, Metallurgy, Architecture, and in all needful collateral studies. A School of General Literature is also established and thoroughly equipped, with three departments, called respectively the Classical, the Latin-Scientific, and that of Science and Letters.

### TUITION.

The following charges are made for tuition :

For students in the Technical courses, \$100 per annum: \$60 for the first term, \$40 for the second term ; for stu-

dents in the school of General Literature, \$60 per annum: \$40 for the first term, \$20 for the second term.

These fees include all tuition, with the use of the Library and Gymnasium, but the student is charged for materials and apparatus consumed in the Laboratories.

The Trustees have placed at the disposal of the Faculty a limited number of scholarships, to be awarded to applicants of good moral character who shall pass the entrance examinations creditably, and who for other cause shall be regarded as worthy by the Faculty.

Applications for these free scholarships should be made to the President of the University, who will furnish all needed information concerning the regulations which govern their bestowal.

All fees for tuition are payable to the Treasurer of the University in two instalments, as above. The first instalment is to be paid to the treasurer of the University on or before October 10; the second on or before January 20.

Students who fail to pay tuition fees when due will be notified by the President that their attendance at college exercises must be discontinued until payment is made.

Every candidate for a degree is required to pay a graduation fee of \$10, before the degree is conferred.

### PUBLIC WORSHIP.

Prayers are held in the Packer Memorial Church of the University every morning and all students are required to be present.

Divine service is held every Sunday morning in the church. The service is according to the forms of the Protestant Episcopal Church, under whose auspices the University was placed by its Founder. Attendance is required of every student, except in case of those connected with other religious bodies, to whom the President will grant permission at the beginning of each term (if requested by the parent or guardian, or by the student himself if

he be 21 years of age) to attend during that term the place of worship of the body with which he is connected, where attendance on Sunday morning will be required.

#### SITE.

The situation of the institution is healthful and beautiful. The region is famous for its railway and manufacturing enterprises: it possesses some of the richest iron and coal mines in our land, and thus gives the students rare facilities for confirming the teachings of the recitation room by the observation of the eye.

The University buildings are about a half-mile from the depot, at the junction of the Lehigh Valley, the New Jersey Central, and the Reading (North Pennsylvania) Railroads. New York is ninety-two and Philadelphia fifty-eight miles distant.

#### BUILDINGS.

##### PACKER HALL,

named after the Founder, stands seven hundred feet back of Packer Avenue, at the base of the South Mountain. It is built of stone, and contains the lecture and recitation rooms of the departments of Philosophy, Greek, Latin, Modern Languages, English, History, and Mathematics; the lecture, recitation, and drawing rooms, and the collections of the departments of Civil, Mechanical, and Mining Engineering, and the museum of geology and natural history.

##### THE CHEMICAL LABORATORY

is thoroughly fire-proof, is built of sandstone, and is 219 feet in length by 44 in width.

There are two principal stories and a basement. The upper floor is occupied by the quantitative and the qualitative chemical laboratories, the former accommodating 48 and the latter 84 students. These rooms are 22 feet in height, and are well lighted and ventilated. A laboratory for industrial chemistry and the supply room are also on this floor.

The first floor contains a large lecture room, a recitation room, a chemical museum, and laboratories for organic, physiological, agricultural, and sanitary chemistry.

In the basement is the large laboratory for the furnace assay of ores and a well appointed laboratory for gas analysis, also rooms containing the apparatus for several processes in industrial chemistry, the engine and air-pump for vacuum filtration, a store room, and the toilet.

A photographic laboratory is located in the third story of the central portion of the building.

#### THE METALLURGICAL LABORATORY

contains a lecture room, a blowpipe laboratory for class instruction in blowpipe analysis and in the practical determination of crystals and minerals, a museum for mineralogical and metallurgical collections, a mineralogical laboratory provided with a Fuess reflecting goniometer, a polariscope, a Groth's "universal apparat," and a Rosenbusch polarizing microscope, a dry laboratory provided with furnaces for solid fuel and for gas with natural draught and with blast, and a wet laboratory for ordinary analytical work. It is arranged for the instruction of classes in the courses of mineralogy, metallurgy, and blowpipe analysis of the regular curriculum, and to afford facilities to a limited number of advanced students for familiarizing themselves with the methods of measurement and research employed in mineralogy and metallurgy, and for conducting original investigations in these departments of science.

#### THE PHYSICAL LABORATORY.

This building is of stone, 235 feet in length, and 4 stories in height. The first or ground floor is devoted to electrical work, and forms the Senior Electrical Laboratory. It contains a large dynamo room, with the engine, dynamos, and motors, with all their appliances; battery, balance, calorimetric rooms and workshops. The eastern part of this story has been carefully arranged for delicate work. The use of iron has been avoided; the gas and steam mains and pipes, radiators, etc., are all of brass. In this section

are seven special rooms for investigations of the magnetic properties of iron and for original research. A hall over 200 feet in length can be darkened and utilized for long range work in testing lamps. Under this floor is the "cave" or even-temperature room, completely enclosed with solid stone masonry. On this and the other three floors are private laboratories, store and apparatus rooms, and offices for instructors.

The second story contains the Junior Electrical Laboratory, 56 by 44 feet; the Mechanical Laboratory, 60 by 44 feet, with tables for 80 students, the Library, a time room and two balance rooms, with floors resting on solid stone arches.

On the third floor is a public hall, 70 by 44 feet, for examinations; also the professor's lecture room, 40 by 44 feet, with private laboratories, etc.

On the fourth floor in the west wing are two recitation rooms for the instructors, 40 by 18 feet, and the Heat Laboratory, 44 feet square, with tables for 72 persons. On the east side is the Light Laboratory. This contains one room with tables for 40 persons, and 8 smaller dark rooms, each of which can be divided into two parts. Besides these are 4 photographic dark rooms, 8 by 28 feet each, each with all the necessary equipments.

The tower, which is devoted to meteorological purposes, has two stories of one room each, 16 by 21 feet, with a vane room above. Besides these there are several small rooms for special purposes scattered among the four floors.

The tendency in the latest and best Physical Laboratories is towards a larger number of smaller rooms, rather than to a few large rooms. It will be seen from this description that the advantages of this plan have been gained by the many smaller rooms that exist, while for general work the larger halls are provided.

Three staircases, at the middle and the two ends of the building, afford ample means of entrance and egress.

**THE SAYRE OBSERVATORY.**

Near Brodhead Avenue is the Sayre Observatory, the gift of Robert H. Sayre, Esq., of South Bethlehem, containing an equatorial and a zenith telescope, transit instrument, and astronomical clock.

**THE PACKER MEMORIAL CHURCH**

is the munificent gift of Mrs. Mary Packer Cummings, daughter of the Founder of the University. It is one of the largest and most magnificent Churches in the State, richly furnished and handsomely appointed in every particular.

**THE UNIVERSITY LIBRARY.**

To the east of Packer Hall is the University Library, erected by the Founder in memory of Mrs. Lucy Packer Linderman, his daughter.

**THE GYMNASIUM**

is a handsome and spacious structure, built and equipped with the utmost thoroughness. It is furnished with the best patterns of gymnastic apparatus, besides Dr. Sargent's system of developing appliances. It is provided with hot and cold water; tub, sponge, and shower baths, and 389 clothes closets. Opportunities for recreation and amusement are provided in the bowling alleys. It is under the immediate care of a skilled and competent Director.

All students are required to undergo a physical examination before being allowed the use of the Gymnasium, and this examination will be repeated once each year during their stay at the University. The proper exercise is prescribed and is required of every student. These regulations are designed to promote the harmonious, symmetrical development of the individual student.

**EXPENSES.**

Books, materials, paper, pencils, materials used in the chemical laboratories, and drawing instruments are furnished by the student. Materials consumed in the chemical laboratories can be obtained from the University, their

value being covered by a deposit made at the opening of that term in which the laboratory work is to be done.

Rooms and board cannot be had in University buildings, but can readily be obtained in many private houses.

The following is an estimate of the necessary expenses for the collegiate year, clothing and traveling not included :

Tuition, . . . . .	\$100	\$100
Board for 40 weeks, . . . . .	from 160	to 200
Room-rent, with fuel and lights . . . . .	40	" 80
Care of room and use of furniture, . . . . .	5	" 20
Washing and incidentals, . . . . .	20	" 40
Books, stationery, etc., . . . . .	25	" 50
Total, . . . . .	\$350	to \$490

(In the case of students in the School of General Literature, the totals will be \$310 to \$450.)

NOTE.—If clubs be formed the cost of board need not exceed \$3.50 per week.



## ADMISSION OF STUDENTS.

The Register is intended to give all necessary information concerning the admission of students. Application may be made to the President of the University if information is desired which is not given in the Register.

### DATE OF EXAMINATIONS.

Examinations for admission to the University are held at the opening of each term, and also in June at the close of the academic year.

The examinations for 1896 will be on Monday, Tuesday, and Wednesday, January 6, 7, and 8, for admission to the second term; on Thursday, Friday, and Saturday, June 18, 19, and 20, and on Saturday, Monday, and Tuesday, September 19, 21, and 22, for admission to the first term. No other examinations for admission will be held, except for good cause, and all applicants *must* be in attendance at 9 o'clock on the morning of the first day.

The examinations are held in June and September in the following order :

*First Day.*—English, 9 A.M.; Arithmetic, 11 A.M.; Physics, 2 P.M.; Latin and Roman History, 2 P.M.

*Second Day.*—Geometry, 8.30 A.M.; Physical Geography, 11.30 A.M.; Geography, 3 P.M.; United States History, 4 P.M.

*Third Day.*—Algebra, 8.30 A.M.; Greek and Greek History, 2 P.M.

The schedules of examinations for applicants for admission to the Freshman Class at the beginning of the second term and to the Sophomore Class at the beginning of the first term may be obtained from the Secretary of the Faculty. Examinations at other than the appointed times can not be

granted without great inconvenience, and candidates so applying will be required to pay a fee of \$5 into the Faculty's fund for the aid of indigent students.

#### CHARACTER OF THE EXAMINATIONS.

The examinations are rigorous and cover the entire ground laid down in the following scheme. They are all conducted in writing, supplemented by an oral examination at the option of the examiner.

Each candidate for admission must be at least sixteen years of age, and must present a testimonial of good moral character from his last instructor, or from the school or institute to which he last belonged, or from some reputable citizen of the community in which he lives.

Candidates for admission to

#### THE CLASSICAL COURSE

are examined in the following subjects:

1. *English*.—This requirement includes: (*a*) English Grammar, especial attention being given to the analysis and correction of sentences; and (*b*) Rhetoric and Composition. Any High School Rhetoric, such as those of Hart, Hill, Williams, Kellogg, and others of a like grade, will be sufficient, together with practical exercises in composition.

Greater stress will be laid, year by year, upon accurate and idiomatic use of the vernacular, upon correct pronunciation, clearness and facility in expression and in the presentation of ideas, an acceptable style in writing,—in short, upon all that may fairly be expected of the student as the result of a thorough and intelligent preparation in English. To gain this end, it may be well to use the list of books prescribed for admission to the New England colleges. These are, for 1896, Shakespeare's *Midsummer Night's Dream*; Defoe's *History of the Plague in London*; Irving's *Tales of a Traveller*; Scott's *Wood-*

stock; Macaulay's Essay on Milton; Longfellow's Evangeline; George Eliot's Silas Marner. For these may be substituted the books announced in the Register for 1894-95, viz., Scott's Lady of the Lake, Dickens's David Copperfield, Irving's Sketch Book, Hawthorne's Marble Faun. The books prescribed for 1897 are as follows: Shakespeare's As You Like It; Defoe's Journal of the Plague Year in London; Irving's Tales of a Traveller; Hawthorne's Twice Told Tales; Longfellow's Evangeline; George Eliot's Silas Marner. The student is also urged to the fullest possible use of all the opportunities for vocal culture which his means of preparation afford.

Attention is called to the fact that the right is reserved to regard hereafter all examination papers, upon whatever subject, as part of the English examination.

2. *Geography*, general and political.

3. *History of the United States*, including the *Constitution*.

4. *Arithmetic*, including the metric system of weights and measures.

**Note.**—In 1897, and thereafter, *Arithmetic* will be omitted from the requirements for admission.

5. *Algebra*.—Fundamental principles. Factoring. Least common multiple. Greatest common divisor. Fractions. Involution. Evolution. Radicals. Imaginary quantities. Equations of the first and second degrees. Ratio. Proportion and progressions.

[Olney's University Algebra or Meaker's Elements of Algebra is recommended for preparation.]

6. *Geometry*.—Fundamental principles. Rectilinear figures. The circle. Proportional lines and similar figures. Comparison and measurement of the surfaces of rectilinear figures.

[Chauvenet's Geometry (four books) is recommended, that being the text-book used in the University.]

7. *Physical Geography*.

8. *Latin Grammar*.

9. *Cæsar*, four books of the Gallic war.

10. *Cicero*, six orations, including the four against Catiline.

11. *Vergil*, the first six books of the *Æneid*, including Prosody.

12. The translation, at sight, of passages from Cæsar and Cicero.

13. The translation of English into Latin. (As special importance is given this part of the examination, it is suggested to teachers that they connect exercises in making Latin, both oral and written, with all the studies of the preparatory course.)

14. *Roman History*.—Creighton, Pennell, or Myers.

15. *Greek Grammar*.

16. *Xenophon*, *Anabasis*, four books.

17. *Homer*, *Iliad*, first three books, including Prosody. The Catalogue of Ships may be omitted.

18. The translation, at sight, of a passage from some work of Xenophon.

19. *Greek History*.—Fyffe, Pennell, or Myers.

20. Writing Greek with accents.

The pronunciation of Greek according to the written accents is followed in the University, and it is desirable that students preparing to enter be taught this system.

Latin is pronounced according to the method generally known as the Roman Method.

#### THE LATIN-SCIENTIFIC COURSE.

Candidates for admission to this course must present the first fourteen of the above requirements, but substitute for the Greek sections (numbers 15-20 inclusive) the following:

21. *Geometry*.—Regular polygons. Measurement of the circle. Maxima and minima of plane figures, and plane and polyhedral angles: these constituting the subject matter of Books Five and Six of Chauvenet's *Geometry*.

## THE COURSE IN SCIENCE AND LETTERS.

Candidates for admission to this course are examined in all the subjects demanded of those entering the Latin-Scientific Course, except the Latin and Physical Geography sections (numbers 7-14 inclusive). They also present the following:

22. *Elementary Physics.*

[Avery's Elements of Natural Philosophy (revised edition) is recommended; or Gage's Elements of Physics, if studied as intended by the author, with practical work in the laboratory by the student and the calculation of problems arising in the work.]

## THE SCHOOL OF TECHNOLOGY.

Candidates for admission to the Courses in Civil Engineering, Mechanical Engineering, Mining Engineering, Electrical Engineering, Chemistry, and Architecture are examined in the following subjects:

1. *English.*—This requirement includes: (*a*) English Grammar, especial attention being given to the analysis and correction of sentences; and (*b*) Rhetoric and Composition. Any High School Rhetoric, such as those of Hart, Hill, Williams, Kellogg, and others of a like grade, will be sufficient, together with practical exercises in composition.

Greater stress will be laid, year by year, upon accurate and idiomatic use of the vernacular, upon correct pronunciation, clearness and facility in expression and in the presentation of ideas, an acceptable style in writing,—in short, upon all that may fairly be expected of the student as the result of a thorough and intelligent preparation in English. To gain this end, it may be well to use the list of books prescribed for admission to the New England colleges. These are, for 1896, Shakespeare's *Midsummer Night's Dream*; Defoe's *History of the Plague in London*; Irving's *Tales of a Traveller*; Scott's *Woodstock*; Macaulay's *Essay on Milton*; Longfellow's *Evangeline*; George Eliot's *Silas Marner*. For these may be substituted the books announced in the Register for 1894-1895, viz., Scott's *Lady of the Lake*,

Dickens's *David Copperfield*, Irving's *Sketch Book*, Hawthorne's *Marble Faun*. The books prescribed for 1897 are as follows: Shakespeare's *As You Like It*; Defoe's *Journal of the Plague Year in London*; Irving's *Tales of a Traveller*; Hawthorne's *Twice Told Tales*; Longfellow's *Evangeline*; George Eliot's *Silas Marner*. The student is also urged to the fullest possible use of all the opportunities for vocal culture which his means of preparation afford.

Attention is called to the fact that the right is reserved to regard hereafter all examination papers, upon whatever subject, as part of the English examination.

It is recommended that candidates have a knowledge of Latin Grammar, although an examination in it is not required for any courses except the Classical and the Latin-Scientific.

2. *Geography*, general and political.
3. *History of the United States*, including the *Constitution*.
4. *Arithmetic*, including the metric system of weights and measures.

**Note.**—In 1897, and thereafter, *Arithmetic* will be omitted from the requirements for admission.

5. *Algebra*.—Fundamental principles. Factoring. Least common multiple. Greatest common divisor. Fractions. Involution. Evolution. Radicals. Imaginary quantities. Equations of the first and second degrees. Ratio. Proportion and progressions.

[Olney's University Algebra or Meaker's Elements of Algebra is recommended for preparation.]

6. *Geometry*.—Fundamental principles. Rectilinear figures. The circle. Proportional lines and similar figures. Comparison and measurement of the surfaces of rectilinear figures. Regular polygons. Measurement of the circle. Maxima and minima of plane figures, and plane and polyhedral angles; these constituting the subject matter of the first six books of Chauvenet's *Geometry*.

[Chauvenet's *Geometry* is recommended, that being the text-book used in the University.]

**Note.**—In 1897, and thereafter, the examinations for admission to the Freshman Class in the School of Technology will include Solid Geometry.

7. *Elementary Physics.*

[Avery's Elements of Natural Philosophy (revised edition) is recommended; or Gage's Elements of Physics, if studied as intended by the author, with practical work in the laboratory and the calculation of problems arising in the work.]

Division of Examinations for Admission.

Candidates for admission to the Freshman Class may pass all the examinations in June, or all in September, or partly in June and partly in September, or may take them in *two consecutive years*. In the latter case, for the Technical courses and the course in Science and Letters, candidates may present themselves for examination in the first year in the following subjects: English, Geography, History of the United States, and Arithmetic. No credit will be given unless the candidate has passed satisfactorily in at least three subjects at one examination.

The examinations in Algebra, Geometry, and Physics must be passed in June or September of that year in which the candidate proposes to enter the University.

In the Latin-Scientific and Classical courses candidates may present themselves for examination in the first year in the following subjects: English, Geography, History of the United States, Arithmetic, Physical Geography, Roman History, and Greek History. No credit will be given unless the candidate has passed at least four of the subjects at one examination.

The examination in Latin may also be divided, but no credit will be given unless the candidate has passed in at least three of the topics specified at one examination. The examinations in the remaining subjects must be passed in June or September of that year in which the candidate proposes to enter the University.

Candidates intending to enter the University in September are advised to present themselves for examination in

June; if they are not fully prepared at that time they will receive credit for the examinations then satisfactorily passed.

#### CONDITIONAL ADMISSION.

A candidate failing to pass in one or more of the subjects required for admission may, at the discretion of the Faculty, be admitted to his class conditionally, to make up his deficiencies by extra study. When they are made up, he will be received into full standing in his class.

#### SPECIAL STUDENTS.

Young men of advanced standing, who do not desire to take a full regular course, can enter and select special shorter courses, with the sanction of the Faculty; but in all cases satisfactory examinations must be passed upon the subjects required for entrance to the Freshman Class.

#### ADMISSION TO ADVANCED STUDIES.

Candidates for admission to advanced studies *in any course* are required to pass, *in addition to the entrance examinations for that course*, examinations in the work already done by the classes which they desire to enter. These examinations are held on the same days as those for entrance to the Freshman Class.

The additional subjects may be found in the program of studies.

A diploma showing that a degree has been conferred, or a certificate of studies taken at another College will be received, in so far as it covers the subjects required for entrance, in lieu of the *Primary Entrance Examinations only*.

#### ADMISSION TO GRADUATE COURSES.

Students of this University who have taken their *first* degree, and others, on presenting a diploma of an equivalent degree conferred elsewhere, are admitted to advanced studies, according to the plan to be found in the Register under the general subject of Graduate Students.



## PREPARATORY SCHOOL CERTIFICATES.

The acceptance of a certificate as evidence of proficiency in lieu of examination is at the discretion of each Professor as to the subjects in his department. It has been the custom to accept certificates from schools of high standing in English, Geography, and United States History, but not in Mathematics or Physics. Beginning with the examinations of June, 1897, such certificates will not, as a rule, be accepted so as to dispense with the primary entrance examination in any subject. It is, however, regarded as highly desirable that the examiners should receive from principals of preparatory schools statements with reference to those whom they send up as candidates for entrance, indicating as clearly and fully as possible, in each case, the teacher's opinion of the candidate's character and scholarship and fitness for entering upon collegiate work; and such statements will receive careful consideration, in connection with the results of the entrance examinations.

## PROGRAM OF STUDIES.

Showing the number of exercises per week for each subject, and the Text-books used.

The following is presented as the general program of instruction, subject to such modifications from time to time as the Faculty may deem expedient, with the approval of the Trustees.

The names of the text-books studied are generally mentioned. The number of exercises per week in each subject is indicated by the figure in parenthesis immediately following.

Two hours of drawing, three of work in the laboratory, or three of practice in the field, are regarded as equivalent to a recitation or lecture of one hour's duration.

## SCHOOL OF GENERAL LITERATURE.

There are three courses in the School of General Literature of the University.

I. The Classical Course includes all that is prescribed in our best institutions for the degree of Bachelor of Arts (B.A.). It covers full instruction in Greek, Latin, English, French and German, Mathematics, Astronomy, Physics, Chemistry, Geology, Physiology, Hygiene, History, Psychology, Ethics, Philosophy, Political Economy, and Constitutional Law.

II. The Latin-Scientific Course differs from the first in omitting Greek, taking in its place an increased amount of the Modern Languages and of Mathematics. Students completing this course receive the degree of Bachelor of Science (B.S.).

III. The Course in Science and Letters, for which the same degree is given as for the last mentioned, contains no Latin or Greek, but furnishes instead extended instruction in French and German, History, General Literature, Mathematics, and General Science.

Instruction in all of these courses is given both by recitations and by lectures.

A student taking a literary course will be permitted to substitute, at the discretion of the Faculty, studies offered in one or another of the technical courses for a portion of the required work during Junior and Senior years. Such a student will receive the literary degree at the end of the fourth year. If he then desires to pursue the remaining branches in the technical course, he may receive the appropriate degree as soon as this is completed. The amount of additional time thus occupied will be probably from one and a half to two years, depending upon the courses selected and the diligence of the student.

It is believed that the benefit from such a combined course, which unites the advantages of literary training with a professional course, will recommend itself to many persons, and that the maturer condition of the student when he approaches his later work will enable him to make better use of the opportunities then afforded him.

## DESCRIPTION OF THE COURSES.

GREEK.—During the first term of Freshman year the class reads several books of the *Odyssey*, giving attention to epic forms and syntax, to prosody and scanning, and to Homeric antiquities and mythology. The work of the second term is directed toward a thorough acquaintance with the idiom and vocabulary of Attic prose, as a preparation for rapid reading. The *Æconomus* and *Symposium* of Xenophon and the *Crito* of Plato are read during the term, with sight readings from the *Memorabilia* and the *Apology*; accompanied with discussions of domestic life at Athens. The work of the year includes a thorough re-

view-drill on the principles of Greek accidence and syntax, and exercises in Greek prose composition are required, based, during the second term, on the reading done by the class. Greek history is studied throughout the year, with special reference to the development of political institutions.

The Sophomore class takes up, during the first term, the study of Herodotus and Thucydides. Selections are made from both authors with the purpose of illustrating their best style and at the same time of presenting, from the original sources, the history of certain interesting epochs; the reading from Herodotus, after some drill on the Ionic forms, being in large part at sight. During the second term the class reads one or two plays of Euripides, with attention to the history of Greek tragedy, the life of the author, and the analysis of the drama read. The lyric meters are studied, with the aim of gaining a knowledge of the rhythmical and metrical principles of Greek poetry. During this term an elective course is offered, the subject being Greek oratory, with the reading of certain orations of Lysias or Demosthenes, or both.

The Junior year is devoted to a further study of the drama, selected plays of Sophocles, Aristophanes, and Æschylus being read during the year. Work is also done in the study of public and private antiquities, partly in lectures by the professor and partly in original investigation on allotted subjects by the students.

During the first term of the Senior year the class reads either selections from Thucydides, or one of the dialogues of Plato. The second term is in part devoted to the reading of selected odes of Pindar, with careful study of the history of Greek lyric poetry and of the life and work of Pindar in particular. The course concludes with a review of the history of Greek literature, intended to summarize and harmonize the fragmentary views of the general subject gained from the study of particular authors and departments of literature.

**LATIN.**—Much of the training in the Freshman year is devoted to laying a good foundation in Latin grammar and in the translation of English into Latin. The authors studied are used to illustrate both of these, and a large amount is read at sight in order to cultivate quickness and readiness in the student. Roman history is begun, accompanied with full comments and lectures upon points of interest. Collateral reading will also be recommended each year throughout the course. Cicero: *De Senectute* and *De Amicitia* or the *Philippics*, Livy, and the *Odes* and *Epodes* of Horace are read this year. With the last named, training is given in Latin meters.

During this and the following year courses of lectures will be given upon Roman antiquities in addition to a text-book. The topography of Rome with its remains, ancient life in its various aspects, and the other departments of archæology will be discussed, illustrated by the new and extensive set of over 3600 magic lantern slides which have been prepared for this purpose.

The Sophomore year completes the text-book on Roman history. Quintilian (Bk.X) with Crowell's *Selections from the Lyric Poets* will be read in the first term, and in the second the *Agricola* and *Germania*, with selections from the *Annals* of Tacitus, together with sight reading.

In the Junior year, selected letters of Cicero and Pliny are read, followed by Persius and several plays of Terence and Plautus. The history of Roman literature is entered upon in the second term.

The work in the Senior year opens with Lucretius, accompanied with lectures on Roman philosophy. The course in the second term this year includes the study of ancient Latin, using Allen's *Remnants of Early Latin*, supplemented by a series of lectures upon Latin Grammar and the history of the development of the language, together with several lectures upon the history of classical philology. Characteristic poems by various authors will be read with full comment and training in the discussion of the literary and critical points which come up.

HEBREW.—An elementary course in Hebrew, conducted by the Chaplain, is offered as an optional study, open to Seniors and Juniors of the whole University.

ENGLISH.—During the first term, Freshman year, Rhetoric is studied, both with the aid of a text-book and through practical exercises, with the design of stimulating invention and imparting the essentials of a clear prose style. In the second term, a brief history of the language is made the nucleus of work.

The Sophomores spend the first term in a careful study of all that is most typical in American literature; the second, in a critical study of the prose of DeQuincey, Macaulay, and Carlyle, following that with a rapid survey of English prose from the XIV to the XIX century.

The Juniors study models of the best Oratory, both English and American, as a preliminary to the writing and delivery of original orations at some time during the first term; and, during the second, specimens from the works of standard Essayists as models for original essays. Careful training is given in the writing and criticism of essays throughout the course. These will be frequent rather than long; on subjects partly literary and in part technical; and the student will be led to maintain a specific thesis with orderly balance of arguments and arrangement of parts. The usual aimless discussion of what are styled "common terms," will be discouraged.

Excellence in Oratory is encouraged by the annual contest for the Alumni Prizes, held on the 22d of February, and open to students of the Junior class in all courses.

Instruction in elementary Anglo-Saxon is given regularly for one term to the Juniors in the School of General Literature, to be followed in the next term by a more critical study of the philology and history of the language than would be possible without such an introduction.

Seniors in the same school receive instruction in the early English of Chaucer and his contemporaries, and in the principles and practice of versification. They are required to write a short poem, or a critique of some book, of a

purely literary cast, selected for their examination and review. The course is completed by a series of lectures on the English poets from Chaucer to Tennyson, and, later, by lectures on special topics in English Literature too important to be passed over with brief mention, yet too comprehensive to be treated earlier in the course. Topics for 1897 will be taken from the following list: (1) Influence of the Celtic Writings and Traditions of Britain on the Literature of England. (2) The Historical and Literary Value of Anglo-Saxon Literature. (3) The English Bible as an English Classic. (4) The Elizabethan Writers. (5) The Greater Victorian Poets.

Optional courses will be offered as occasion arises. A Reading Club will be formed, and the student will be encouraged to such private and supplementary reading as his time will permit, and to the formation of a small library of standard books.

**MODERN LANGUAGES.**—The study of modern languages is obligatory from the first term of the Sophomore year up to the close of the course. The student elects either French or German; or both, if time permits.

*French.*—The grammar is begun, reading being introduced immediately. The comparative and historical relations of the French to the English, and the connection of both with the Latin are carefully explained. As soon as possible the student is emancipated from the Reader and takes up, in a progressive way, the reading of different authors; preference being given to modern writers, because it is considered to be of the highest importance that he acquire the language as it is, as an instrument whereby further knowledge can be obtained.

In the class-room, the language taught is used by the teacher as much as possible, in order that the ear of the pupil may become accustomed to its sound. Dictation is also employed, in order to give training in spelling. The rules of grammar are taught by numerous written exercises. In the second term of the Junior year, compositions

in French are required, upon subjects which have been previously explained in French, in order that the student may become acquainted with different expressions and forms of construction. Before entering upon the study of an author's works, his life and literary achievements are discussed in French, which is translated, if necessary. In the Senior year, twelve lectures are delivered upon the history of French literature. In addition to this, lectures in French upon the most distinguished modern authors are given to advanced students.

A weekly conversation-class affords opportunity for this kind of practice; and in it the events of the day and various historical and literary topics are discussed. Private courses of reading are also suggested to those who desire it.

*German.*—The German course follows the same plan as that laid down for the French, both as regards the methods employed and the opportunities afforded. The relations of English and German are dwelt upon and also those which connect the two languages with the Indo-European family.

**MATHEMATICS.**—The mathematical work is carried on during the Freshman and Sophomore years as follows:

Freshman year, first term, solid geometry, four exercises per week.

Second term, higher algebra; plane and spherical trigonometry, including mensuration and use of logarithmic tables, together five exercises per week throughout the term.

Sophomore year, first term, analytical geometry, four exercises per week.

Second term, differential and integral calculus, four exercises per week. This term's work is elective for the Classical Course.

**ASTRONOMY.**—This study is taken up during the first term of the Senior year, Young's General Astronomy being used as the text-book. There are three exercises a week, and visits to the observatory help to make the work interesting as well as profitable.



**CHEMISTRY.**—This study includes a complete course of lectures in Freshman year upon general inorganic chemistry, in which the principles of the science are fully covered. These are illustrated by experiments, and are sufficiently extended to enable a student who desires to pursue the subject further to take analytical chemistry as an elective in the second term of the Sophomore year. The text-book used in connection with the lectures is Remsen's Inorganic Chemistry.

**PHYSICS.**—This important subject is presented in a course of lectures during the first term of the Sophomore year, three times a week. These are illustrated by means of the very complete apparatus of the physical laboratory. In the course in Science and Letters, the work in this branch is more extended and is identical with that given to the Civil and Mechanical Engineers. It occupies five hours a week in the first term, when heat, magnetism, and electricity are discussed. Throughout the second term, three hours a week are devoted to sound and light.

**GEOLOGY.**—In the second term of the Senior year, a course of lectures is given in connection with Le Conte's text-book. The general principles of the science are explained, and the theories of the formation and stratification of rocks, the successive periods of the development of the earth's crust, the extinct forms of life and similar questions are treated.

**PHYSIOLOGY AND HYGIENE.**—These subjects are taught in a course of lectures during the Freshman year.

**HISTORY AND POLITICAL SCIENCE.**—The study of history begins with a course in the political antiquities of Greece and Rome. [See the Departments of Greek and Latin.] This is followed by the study of an outline of universal history (with text-book), and this by a fuller study of the political history of recent times, especially of that of England and France. During the first term of Senior year, there is a course of lectures upon the period covered by Gibbon's Decline and Fall of the Roman Empire.

The course in history is accompanied and supplemented by courses of lectures on constitutional law with special application to the Constitution of the United States; and also on international law.

Instruction is given by lectures on the elements of political economy. The student is made familiar with the facts, methods, and doctrines of the science, and is encouraged to form and present his own opinions.

LOGIC.—Junior Class, first term, two hours weekly. Text-book, Prof. Jevons' "Lessons in Logic," supplemented by occasional lectures and by references to more extended logical treatises, such as those of J. S. Mill, Sir William Hamilton, Archbishop Thompson, Baynes' Port Royal Logic, etc.

MENTAL AND MORAL PHILOSOPHY.—The work in this department will be conducted chiefly by lectures, interrupted by occasional examinations. The courses at present are the following:

*Outlines of Physiological Psychology.*—Junior Class, second term. These lectures are founded principally on Wundt's lectures on the same subject, Wundt's *Grundzüge der Physiologischen Psychologie*, James' *Psychology*, Baldwin's *Handbook*, Ladd's *Elements of Physiological Psychology*, Lotze's "Medicinische Psychologie," Ranke's "Der Mensch," Sully's *Outlines of Psychology*, Carpenter's *Mental Physiology*, Maudsley's *Physiology and Pathology of the Mind*, Bain's *Mind and Body*, etc., with references to the classical works of Weber, Fechner, and Helmholtz.

*The History of Philosophy.*—Senior Class, both terms. First term, Ancient and Medieval Philosophy. Second term, Modern Philosophy. These lectures will include a statement of the conception and problems of philosophy, a brief sketch of the great ethnical religions, and of the history of Oriental philosophy. The philosophy of the Greeks will be treated in detail, with illustrations from the writings of the philosophers.

The history of medieval philosophy will be prefaced by a short description of the philosophical ideas underlying

Christianity, and it will contain an account of the more important Church Fathers and Schoolmen.

The history of modern philosophy will begin by tracing the effect on philosophical thought of the ideas contributed by the Renaissance and by the Reformation. From Lord Bacon on, a detailed history of the great modern philosophical systems will be given, which will be continued to those of our own times, including that of Mr. Spencer.

**ANTHROPOLOGY.**—Senior Class, both terms. These lectures aim at laying the foundation of a scientific study of Man. They include the rudiments of anthropometry and craniology. The earlier lectures give an account of the development, structure, and life of the human body; while the later lectures endeavor to describe the salient peculiarities of existing and prehistoric races of men.

They are based, for the most part, on the works of Bischoff, Broca, Darwin, Hartmann, Haeckel, Huxley, Quételet, Ranke, Virchow, etc.

**CHRISTIAN EVIDENCES.**—Senior Class, second term. Lectures on Christian evidences, which will endeavor to treat of the subject both from the side of natural science and from that of biblical criticism.

No complete course in Ethics has as yet been established, but the history of ethics is included in the history of philosophy.

#### THE COURSE IN SCIENCE AND LETTERS

substitutes the following for the Latin and Greek:

**DRAWING.**—In the first term of the Freshman year the student is instructed in elementary projections, shading, and lettering.

**ZOOLOGY AND BIOLOGY.**—The study of these subjects covers one year, beginning with the second term of Sophomore year. The work begins with a description of the various animal functions, and is extended to the comparative anatomy and physiology of the organs in typical species. Systematic zoölogy is then completed and followed by practical biology.

**CHEMISTRY.**—In addition to the course in general chemistry described above, three exercises a week in qualitative analysis are taken in the second term of the Freshman year.

**MINERALOGY.**—Instruction in mineralogy is given to the students in the Course in Science and Letters throughout the Junior year. In the first term, they attend a course of lectures on crystallography, followed by a series of practical exercises in the determination of crystalline forms by the aid of models and natural crystals.

In the second term a course on the physical properties of minerals and on descriptive mineralogy, with the use of E. S. Dana's Text-Book of Mineralogy, is followed by practical exercises in the determination of minerals.

**GEOLOGY.**—The study of lithology is pursued in the first term of the Senior year, with laboratory practice, Williams' Lithology being used as the text-book. During the next term, the course given above is taken with the Classical and Latin-Scientific students.

## THE CLASSICAL COURSE.

### FRESHMAN CLASS.

#### FIRST TERM.

- Mathematics.*—Solid geometry. (3) Plane trigonometry. (1)
- Chemistry.*—Lectures. Remsen's Inorganic Chemistry. (3)
- Greek.*—Homer: Odyssey. Prosody. (3)
- Latin.*—Cicero: De Senectute and De Amicitia. Livy begun. Prose composition. (3)
- Physiology and Health.*—Lectures. (1)
- English.*—Rhetoric. (1) Essays.

#### SECOND TERM.

- Mathematics.*—Algebra. (3) Plane and spherical trigonometry and mensuration. Use of logarithmic tables. (2)
- Greek.*—Xenophon: (Economicus. (3)

*Latin*.—Livy completed. Horace: Odes and Epodes. Composition and prosody. (4)

*History*.—History of Greece. (2) History of Rome. (1) Roman antiquities.

*English*.—Rhetoric. (1) Essays.

### SOPHOMORE CLASS.

#### FIRST TERM.

*Mathematics*.—Analytical geometry. (5)

*Physics*.—Lectures. (3)

*French*.—Whitney's Practical French Grammar. Super's French Reader. (2) Or *German*.—Brandt's Grammar. Lode-man's Manual of Exercises. Buchheim's Reader. (2)

*Greek*.—Herodotus. (3)

*Latin*.—Horace: Satires and Epistles. Composition. (2)

*History*.—History of Rome. (1) Antiquities.

*English*.—American literature. (1) Essays.

#### SECOND TERM.

*French*.—Grammar and reader (continued). (2) Or *German*.—Grammar, exercises, and reader (continued). (2)

*History*.—Weber's Outlines of Universal History. (2)

*Greek*.—Euripides: Medea. (3)

*Latin*.—Tacitus: Agricola, Germania, and Annals, or Quintilian: Book X. Composition. (3) Antiquities.

*English*.—English prose literature. (1) Essays.

*In addition to the above exercises, four hours per week must be selected from the following elective studies:*

*Mathematics*.—Differential and integral calculus. (4)

*Greek*.—Demosthenes: De Corona. (2)

*Latin*.—Plautus. (2)

*French*.—Grammar and reader. (2)

*German*.—Grammar and reader. (2)

*Chemistry*.—Stoichiometry and qualitative analysis (laboratory). (4)

## JUNIOR CLASS.

## FIRST TERM.

*History*.—Wilhelm Müller's Political History of Recent Times, and lectures. (2)

*Philosophy*.—Jevons's Lessons in Logic. (2)

*English*.—Anglo-Saxon. (2) English and American Orators. (1)

*French*.—Grammar. George Sand: *La Mare au Diable*. Dumas: *Pauline*. (2) Or *German*.—Grammar. Bernhardt's *Novelletten-Bibliothek*, II. (2)

*Greek*.—Sophocles: *Antigone*. Antiquities. (3)

*Latin*.—Letters of Cicero and Pliny. (3)

## SECOND TERM.

*History*.—History of England: Hume. (3)

*Philosophy*.—Lectures on the outlines of physiological psychology. (2) Political economy. (1)

*English*.—Philology of the English Tongue. (2) British Essayists. (1)

*French*.—Vigny: *Le Cachet Rouge*. Hugo: *La Chute*. Dictation. (2) Or *German*.—Buchheim's *Prose Composition*. Riehl: *Culturgeschichte Novellen*. Freytag: *Aus dem Staat Friedrichs des Grossen*. Dictation. (2)

*Greek*.—Aristophanes: *Clouds*. Æschylus: *Prometheus*. (3)

*Latin*.—Persius, Plautus, and Terence. History of Roman literature. (3)

## SENIOR CLASS.

## FIRST TERM.

*History*.—Decline and Fall of the Roman Empire: Gibbon. (3)

*Philosophy*.—Lectures on the history of ancient and mediæval philosophy. (2)

*Astronomy*.—Young's General Astronomy. (3)

*English*.—Chaucer and his contemporaries. (2)

*French*.—Sadler; Readings in Corneille, Racine, Molière, etc., and contemporary authors. Compositions. Lectures on French literature. (2) Or *German*.—Grammar. Readings in Lessing, Herder, Goethe, Schiller, etc., and contemporary authors. Compositions. Lectures on German literature. (2) Conversation class in both languages optional throughout the year.

*Greek*.—Plato: Phædrus. Greek philosophy. (2)

*Latin*.—Lucretius, with lectures. Roman literature. (2)

#### SECOND TERM.

*History*.—History of France. (2)

*Philosophy*.—Lectures on the history of modern philosophy. (2)

*Christian Evidences*.—Lectures. (1)

*English*.—Study of versification. (2)

*French*.—Readings. Compositions. Lectures in French on modern French authors. (2) Or *German*.—Readings. Compositions. Lectures in German on modern German authors. (2)

*Geology*.—Lectures. Le Conte. (2)

*Greek*.—Pindar: selected odes. Greek literature. (2)

*Latin*.—Cicero: De Officiis. Lectures on the history of classical philology. (2)

*Preparation of Thesis*.

#### THE LATIN-SCIENTIFIC COURSE.

The Latin-Scientific Course, leading to the degree of Bachelor of Science (B.S.), is based on Latin without Greek.

#### FRESHMAN CLASS.

##### FIRST TERM.

*Mathematics*.—Solid geometry. (3) Plane trigonometry. (1)

*Chemistry*.—Lectures. Remsen's Inorganic Chemistry. (3)

*German*.—Joynes-Meissner's Grammar. Buchheim's Reader. (3)

*Latin*.—Cicero: De Senectute and De Amicitia. Livy begun. Prose composition. (3)

*Physiology and Health*.—Lectures. (1)

*English*.—Rhetoric. (1) Essays.

## SECOND TERM.

*Mathematics*.—Algebra. (3) Plane and spherical trigonometry and mensuration. Use of logarithmic tables. (2)

*German*.—Grammar. Reader (continued). Bernhardt's Novelletten-Bibliothek, I. (3)

*History*.—History of Greece. (2) History of Rome. (1) Roman antiquities.

*Latin*.—Livy (completed). Horace: Odes and Epodes. Composition and prosody. (4)

*English*.—Rhetoric. (1) Essays.

## SOPHOMORE CLASS.

### FIRST TERM.

*Mathematics*.—Analytical geometry. (5)

*Physics*.—Lectures. (3)

*French*.—Whitney's Practical French Grammar. Super's Reader. (2)

*German*.—Harris's Prose Composition. Bernhardt's Novelletten-Bibliothek, II. (2)

*History*.—History of Rome. (1) Antiquities.

*Latin*.—Horace: Satires and Epistles. Composition. (2)

*English*.—American literature. (1) Essays.

### SECOND TERM.

*Mathematics*.—Differential and integral calculus. (4)

*French*.—Grammar. Reader (continued). (2)

*German*.—Harris. Riehl: Culturgeschichtliche Novellen. Freytag: Aus dem Staat Friedrichs des Grossen. Dictation. (2)

*History*.—Weber's Outlines of Universal History. (2)



*Latin*.—Tacitus: Agricola, Germania, and Annals, or Quintilian: Book X. Composition. (3) Antiquities.

*English*.—English prose literature. (1) Essays.

### JUNIOR CLASS.

#### FIRST TERM.

*History*.—Wilhelm Müller's Political History of Recent Times, and lectures. (2)

*Philosophy*.—Jevons's Lessons in Logic. (2)

*English*.—Anglo-Saxon. (2) English and American Orators. (1)

*French*.—Grammar. George Sand: La Mare au Diable. Dumas: Pauline. (2)

*German*.—Readings in Lessing, Herder, Goethe, Schiller, and contemporary authors. Dictation. Compositions. (2) Conversation class in German optional throughout the year.

*Latin*.—Letters of Cicero and Pliny. (3)

#### SECOND TERM.

*History*.—History of England: Hume. (3)

*Philosophy*.—Lectures on the outlines of physiological psychology. (2) Political economy. (1)

*English*.—Philology of the English Tongue. (2) British Essayists. (1)

*French*.—Vigny: Le Cachet Rouge. Hugo: La Chute. Dictation. (2)

*German*.—Readings (continued). Dictation. Compositions. (2)

*Latin*.—Persius, Plautus, and Terence. History of Roman literature. (3)

### SENIOR CLASS.

#### FIRST TERM.

*History*.—Decline and Fall of the Roman Empire: Gibbon. (3)

*Philosophy*.—Lectures on the history of ancient and medieval philosophy. (2)

*Astronomy*.—Young's General Astronomy. (3)

*English*.—Chaucer and his contemporaries. (2)

*French*.—Readings in Corneille, Racine, Molière, etc., and contemporary authors. Lectures on French literature. (2)

*German*.—Readings (continued). Compositions. Lectures on German literature. (1) Conversation class in both languages optional throughout the year.

*Latin*.—Lucretius, with lectures. Roman literature. (2)

#### SECOND TERM.

*History*.—History of France. (2)

*Philosophy*.—Lectures on the history of modern philosophy. (2)

*Christian Evidences*.—Lectures. (1)

*Geology*.—Lectures. Le Conte. (3)

*English*.—Study of versification. (2)

*Latin*.—Cicero: De Officiis. Lectures on the history of classical philology. (2)

*French*.—Readings (continued). Compositions. Lectures in French on modern French authors. (2)

*German*.—Readings (continued). Compositions. Lectures in German on modern German authors. (1)

*Preparation of Thesis*.

#### COURSE IN SCIENCE AND LETTERS.

The Course in Science and Letters, leading to the Degree of Bachelor of Science (B.S.), is designed for those who wish to pursue both scientific and literary studies without Latin and Greek. These being omitted, extended instruction is given in French and German, History, General Literature, Mathematics and General Science.

#### FRESHMAN CLASS.

##### FIRST TERM.

*Mathematics*.—Solid geometry. (3) Plane trigonometry. (1)

*Chemistry*.—Lectures. Reimsen's Inorganic Chemistry. (3)

*German*.—Joynes-Meissner's Grammar. Buchheim's Reader. (3)

*Drawing*.—Elementary projections, shading and lettering. (2)

*Physiology and Health*.—Lectures. (1)

*English*.—Rhetoric. (2) Lectures. (1) Essays.

#### SECOND TERM.

*Mathematics*.—Algebra. (3) Plane and spherical trigonometry and mensuration. Use of logarithmic tables. (2)

*Chemistry*.—Lectures and laboratory practice. Douglas and Prescott's Qualitative Analysis. (3)

*History*.—History of Greece. (2) History of Rome. (1)

*German*.—Grammar. Reader (continued). Bernhardt's Novellen-Bibliothek, I. (3)

*English*.—History of the English language. (2) Essays.

#### SOPHOMORE CLASS.

##### FIRST TERM.

*Mathematics*.—Analytical geometry. (5)

*Physics*.—Heat, magnetism, and electricity. Lectures, with study of text-book. (2) Laboratory. (2)

*French*.—Whitney's Practical French Grammar. Super's Reader. (2)

*German*.—Harris's Prose Composition. Bernhardt's Novellen-Bibliothek, II. (2)

*History*.—History of Rome. (1) Antiquities.

*English*.—American literature. (2) Essays.

##### SECOND TERM.

*Mathematics*.—Differential and integral calculus. (4)

*Physics*.—Heat, magnetism, and light. Lectures. (2) Laboratory. (1)

*Zoölogy*.—Lectures. Orton. (2)

*French*.—Grammar. Readings (continued). (2)

*German*.—Harris. Riehl: Culturgeschichtliche Novellen. Freytag: Aus dem Staat Friedrichs des Grossen. (2)

*History*.—Weber's Outlines of Universal History. (2)

*English*.—English prose literature. (2) Essays.

## JUNIOR CLASS.

## FIRST TERM.

*History*.—Wilhelm Müller's Political History of Recent Times, and lectures. (2)

*Philosophy*.—Jevons's Lessons in Logic. (2)

*English*.—Anglo-Saxon. (2) English and American Orators. (1)

*French*.—Grammar. George Sand : La Mare au Diable. Dumas : Pauline. (2)

*German*.—Readings in Lessing, Herder, Goethe, Schiller, and contemporary authors. Dictation. Compositions. (2) Conversation class in German optional throughout the year.

*Zoölogy*.—Lectures on biology. (2)

*Crystallography*.—Lectures, with practical exercises in the determination of crystals. (2)

## SECOND TERM.

*History*.—History of England: Hume. (3)

*Philosophy*.—Lectures on the outlines of physiological psychology. (2) Political economy. (1)

*English*.—Philology of the English Tongue. (2) British Essayists. (1)

*French*.—Grammar. Vigny : Le Cachet Rouge. Hugo : La Chute. Dictation. (2)

*German*.—Lessing, Herder, Goethe, Schiller, Heine, etc. Compositions. (2)

*Mineralogy*.—Descriptive mineralogy, with practical exercises in the determination of minerals. (3)

## SENIOR CLASS.

## FIRST TERM.

*History*.—Decline and Fall of the Roman Empire. (3)

*Philosophy*.—Lectures on the history of ancient and mediæval philosophy. (2)

*Astronomy*.—Young's General Astronomy. (3)

*English*.—Chaucer and his contemporaries. (2)

*French*.—Readings in Corneille, Racine, Molière, etc., and contemporary authors. Compositions. Lectures on French Literature. (2)

*German*.—Readings (continued). Compositions. Lectures on German Literature. (1)

In both languages conversation class optional throughout the year.

*Geology*. — Williams' Lithology and laboratory practice. (2)

#### SECOND TERM.

*History*.—History of France. (2)

*Philosophy*.—Lectures on the history of modern philosophy. (2)

*Christian Evidences*.—Lectures. (1)

*English*.—Study of versification. (2)

*French*.—Readings (continued). Compositions. Lectures in French on modern French authors. (2)

*German*.—Readings (continued). Compositions. Lectures in German on modern German authors. (1)

*Geology*. — Historic and dynamic geology. LeConte. (3)

*Preparation of Thesis*.

## THE SCHOOL OF TECHNOLOGY.

This school includes seven distinct courses:

- I. The Course in Civil Engineering.
- II. The Course in Mechanical Engineering.
- III. The Course in Mining Engineering.
- IV. The Shorter Course in Mining.
- V. The Course in Electrical Engineering.
- VI. The Course in Chemistry.
- VII. The Course in Architecture.

These have the same curriculum of studies for the first term of the Freshman year; except that students who propose to take the course in Mechanical Engineering or that in Analytical Chemistry are required to take German. After the first term the student follows the program of the course which he has selected.

### FRESHMAN CLASS.

#### FIRST TERM.

- Mathematics*.—Solid geometry. (3) Plane trigonometry. (1)
- Chemistry*.—Lectures. Remsen's Inorganic Chemistry. (3)
- French*.—Whitney's Practical French Grammar. Super's Reader. (3) Or *German*.—Joynes-Meissner's Grammar. Buchheim's Reader. (3)
- Drawing*.—Free-hand sketching and lettering. (2)
- English*.—Rhetoric. (2) Lecture. (1) Essays.
- Physiology and Health*.—Lectures. (1)

### THE COURSE IN CIVIL ENGINEERING.

The special technical studies in this course may be grouped under the heads of Surveying, Applied Mechanics, Road and Railroad Construction, Bridge Design, and Hydraulic and Sanitary Engineering.

The work in Surveying extends over four terms and embraces land surveying, leveling, topography, triangulation, railroad reconnaissance and location, hydrography, and the elements of geodesy. A large equipment of transits, levels, and other surveying tools affords students the opportunity of becoming familiar with the instruments of different manufacturers. Much time is devoted to practice in the field and drafting room, each student being required to become proficient in the use of instruments, in taking field notes, and in map-drawing. Particular attention is paid to the execution of topographical surveys and maps by the best modern methods. Railroad maps and profiles are made from actual field location. During the Senior year there is done secondary triangulation work of a high order of precision.

The work in Applied Mechanics comprises the strength and elasticity of materials, the theory of the equilibrium of arches, roofs and bridges, that part of the mechanics of machinery which relates to locomotives and hoisting machines, and the theory of hydraulics and hydraulic motors. Here the theoretical principles are illustrated by examples and problems taken as far as possible from actual engineering practice. Tests and experiments on materials are made in the testing laboratory.

The course in Construction familiarizes the student with the qualities of materials used in engineering structures, with methods of preservation and testing, with masonry and foundations, and with the building and maintenance of roads and railroads. All the standard tests for hydraulic cements and mortars are made by each student.

The course in Bridge Design is preceded by the theory of computation of stresses by both analytical and graphic methods. Starting with the specifications for a first-class iron highway or railroad bridge, each student then makes the full computations, designs, working drawings, and bills of material for a plate girder, a lattice girder, and a pin-connected truss bridge. The weight of the designed bridge is finally determined and compared with the dead load

assumed for the calculations. The drawings are made and dimensioned in the same manner as in the drafting-office of a bridge company. In connection with this course visits of inspection to bridges in the vicinity are regularly made.

The work in Hydraulic and Sanitary Engineering begins with the study of systems of water supply, the collection, purification, and distribution of water, the combined and the separate systems of sewerage, the methods for the disposal of sewage, and the best practice for the drainage of houses. This is followed by the theory of the flow of water in pipes and channels, together with the subject of hydraulic motors.

Besides these special studies there is a course in astronomy, which includes practical work in the observatory. The study of English, and of French or German, is continued, and instruction is given during four terms in crystallography, mineralogy, lithology, and geology.

The student who completes all the studies of this course will receive the degree of Civil Engineer (C.E.).

#### FRESHMAN CLASS.

##### FIRST TERM.

*See page 48.*

##### SECOND TERM.

*Mathematics.*—Algebra. (3) Plane and spherical trigonometry and mensuration. Use of logarithmic tables. (2)

*Construction.*—Materials, masonry, and carpentry. Roads, streets, and pavements. Sketches of structures. (2)

*Projection Drawing.*—Descriptive geometry and isometric drawing. Tracings and drawings of structures. (4)

*French.*—Grammar and reader (continued). (3) Or *German.*—Grammar and reader (continued). Bernhard's *Novelletten-Bibliothek*, I. (3)

*English.*—History of the English language. (2) Essays.



## SOPHOMORE CLASS.

## FIRST TERM.

*Mathematics*.—Analytical geometry. (5)

*Physics*.—Heat, magnetism, and electricity. Lectures, with study of text-book. (2) Laboratory. (2)

*Architectural Drawing*.—Plans of piers and arches. Problems in stone cutting. Use of water colors. (3)

*French*.—Grammar. George Sand: *La Mare au Diable*. Dumas: *Pauline*. (2) Or *German*.—Grammar. Bernhardt's *Novelletten-Bibliothek*, II. (2)

*English*.—American literature. (2) Essays.

## SECOND TERM.

*Mathematics*.—Differential and integral calculus. (4)

*Mechanics*.—Theory of motion, statics, energy, center of gravity, moment of inertia, and general equations of motion. (2)

*Land Surveying*.—Theory and use of compass, level, and transit. Surveys and maps of farms. Leveling. (4)

*Physics*.—Heat, magnetism, electricity, and light. Lectures. (2) Laboratory. (1)

*French*.—Grammar. George Sand: *Le Cachet Rouge*. Hugo: *La Chute*. Dictation. (2) Or *German*.—Grammar. Riehl: *Culturgeschichte Novellen*. Freytag: *Aus dem Staat Friedrichs des Grossen*. Dictation. (2)

*English*.—English prose literature. (2) Essays.

## JUNIOR CLASS.

## FIRST TERM.

*Mathematics*.—Calculus and mechanics. (2)

*Strength of Materials*.—Elasticity and strength of wood, stone, and metals. Theory of beams, columns, and shafts. Work in the testing laboratory. (4)

*Construction*.—Foundations, arches, walls, dams, and bridges. Visits of inspection. (3)

*Topographic Surveying*.—Field work with transit and stadia, and with plane table. Topographic maps. (3)

*Crystallography*.—Lectures, with practical exercises in the determination of crystals. (2)

*French*.—Corneille, Racine, Molière, Hugo, etc. Dictation. Compositions. (2) Or *German*.—Lessing, Herder, Goethe, Schiller, Heine, etc. Dictation. Compositions. (2) Conversation class in both languages optional throughout the year.

*English*.—English and American Orators. (1)

#### SECOND TERM.

*Railroad Surveying*.—Theory of railroad curves. Railroad reconnaissance and location. Survey of a line, with profile, map, and estimate of cost. (4)

*Roofs and Bridges*.—Theory and calculations of stresses in roof and bridge trusses. (4)

*Sanitary Engineering*.—Collection, purification and distribution of water. Systems of water supply and sewerage. Disposal of sewage. House drainage. Irrigation engineering. (3)

*Mineralogy*.—Descriptive mineralogy, with practical exercises in the determination of minerals. (3)

*French or German*.—Readings. Compositions. Lectures on French or German literature. (1) Technical readings. (1)

*English*.—British Essayists. (1)

#### SENIOR CLASS.

##### FIRST TERM.

*Astronomy*.—Young's General Astronomy. (3)

*Bridges*.—Graphic statics. Design of plate girders, riveted bridges, and pin-connected trusses, with working drawings. (7)

*Geodetic Surveying*.—Use of solar transit and sextant. Precise triangulation. Elements of geodesy. Determination of the systematic errors of instruments. (2)

*Mechanics of Machinery.*—Pile drivers, cranes and elevators. The mechanics of the locomotive. (2)

*Geology.*—Williams' Lithology, with practical exercises in determining rocks. (2)

#### SECOND TERM.

*Astronomy.*—Doolittle's Practical Astronomy, with observatory work. (2)

*Bridges.*—Theory of cantilever, draw, continuous, suspension, and arched structures. (3)

*Hydraulics.*—Hydrostatics. Efflux of water from orifices and flow in pipes and rivers. Hydraulic motors. (3)

*Electricity.*—Equipment and operation of electric railways. Measurement of power. (2)

*Geology.*—Historic and dynamic. Le Conte. (3)

*Christian Evidences.*—Lectures. (1)

*Preparation of Thesis.* (3)

#### THE COURSE IN MECHANICAL ENGINEERING.

The object of this course is the study of the Science of Machines. The principal subjects taught are: The nature, equivalence, and analysis of mechanisms, the mechanics or theory of the principal classes or types of machinery, Mechanical Technology, and the principles and practice of Machine Design.

That the students may obtain the practical engineering data which they will most need when beginning their work as mechanical engineers they are required to pursue a course of Shop Instruction which does not necessarily involve manual labor and manipulation of tools, but is principally devoted to familiarizing them with those points in pattern-making, moulding, forging, fitting and finishing, which they need to know as designers of machinery. Particular attention is therefore directed to the forms and sizes of machine parts that can be readily constructed in

the various workshops, to the time that it takes to perform, and the order of, the various operations, to the dimensions most needed by workmen and to the various devices for increasing the accuracy of the work, durability of the parts, and convenience of manipulation. This involves acquaintance with the processes and machinery of the workshops, but it is the foreman's and superintendent's knowledge which is required rather than the manual dexterity and skill of the workman and tool-hand. The acquirements peculiar to the latter are by no means despised and the students are encouraged to familiarize themselves therewith during leisure hours, but manual work in the shops forms no regular part of the course. On the contrary, the student enters the shop with hands and mind free to examine all processes, operations, and machinery, and is ready at the call of the teacher to witness any operation of special interest. Provided with note-book, pencil, calipers, and measuring rule, the student sketches the most important parts of the various machine-tools, notes down the successive steps of each of the important shop-processes as illustrated by the pieces operated upon, and follows the pieces of work through the shops from the pig or merchant form to the finished machine.

That the students may learn to observe carefully and be trained to think and observe for themselves in these matters, there is required of them a full description of the various processes, operations, and tools involved in the production of each one of a series of properly graded examples of patterns, castings, forgings, and finished pieces, which are not being constructed in the shops at the time and the drawings for which have been given to them on entering the shops. The student's work is directed not only by these drawings and by the printed program given him at the start, but also personally by a teacher, who accompanies him into the shops, gives necessary explanations, and tests the extent and accuracy of his knowledge by examining the sketches and notes and by frequent questioning. Finally the results of the observations and the sketches are embodied in a memoir.

During the course there are frequent visits of inspection to the Bethlehem Iron Company, the L. V. R. R. Shops at Easton, and other engineering works both in and out of town, with special reference to such subjects as machine elements, prime movers, machinery for lifting, handling and transporting, and machinery for changing the form and size of materials. It is intended that each of these excursions shall have some definite purpose in view which must be fully reported by the students. These visits are also made the occasion for constant practice in the free-hand sketching of machinery.

The instruction in Machine Design begins with second term of the Freshman year and is continued throughout the course. At first tracings and blue prints of good examples of machine drawings are made. A thorough drill in projection drawing follows; in this work free-hand sketches are first made, and measurements taken, of machine pieces; these sketches are then converted into full-size working drawings. Then there is considerable practice in the interpretation of such drawings, and general views of lathes, planers, drills, and shapers are made from the drawings of the details. This is followed by difficult projections and intersections and exercises in the empirical proportioning of machine parts. Both empirical and rational formulas are used to determine the dimensions of fastenings, bearings, rotating and sliding pieces, belt and toothed gearing, levers and connecting rods, the data being given as they would arise in practice and the drawings made full size. During the Junior year the class takes up the design of a high-speed steam engine, every dimension being determined by the students and complete drawings made. During the Senior year the students undertake the calculations, estimates, and working drawings involved in the design of a simple but complete machine, each student being engaged upon a different machine. From the finished drawings of each machine tracings are made and then blue prints taken for distribution among the other members of the class. In the case of the machines and of the engine the general plan or arrangement will be given to the stu-

dents in the form of rough sketches, photographs, or woodcuts. In the last term the students are expected to make original designs for simple machinery, whose object has been fully explained. Throughout the course the work in the draughting-room is carried on as nearly as possible like that of an engineering establishment, and special attention is paid to methods of expediting the work of calculation by means of simple formulas, tables, and diagrams.

All the students in this course are required to study German.

The graduates in this course will receive the degree of Mechanical Engineer (M.E.).

#### FRESHMAN CLASS.

##### FIRST TERM.

*See page 48.*

##### SECOND TERM.

*Mathematics.*—Algebra. (3) Plane and spherical trigonometry and mensuration. Use of logarithmic tables. (2)

*Drawing and Machine Design.*—Tracings and blue prints. Sketches and working drawings of machine pieces. Interpretation of machine drawing by isometric sketches. General views from given details. Sections of stub ends and valve passages. Intersection of boiler flues. Empirical proportioning of machine parts. (5)

*Visits of Inspection.*—Examination and sketching of principal machine parts in the shops of the vicinity. (1)

*German.*—Grammar and reader (continued). Bernhardt's *Novelletten-Bibliothek*, I. (3)

*English.*—History of the English language. (2) Essays.

#### SOPHOMORE CLASS.

##### FIRST TERM.

*Mathematics.*—Analytical geometry. (5)

*Physics.*—Heat, magnetism, and electricity. Lectures, with study of text-book. (2) Laboratory. (2)

*Machine Design.*—Proportioning of such machine parts as come under the head of fastenings, bearings, rotating and sliding pieces, belt and toothed gearing, levers, and connecting rods. (2)

*Visits of Inspection.*—Examination and sketching of principal machine parts in the shops of the vicinity. (1)

*German.*—Grammar. Bernhardt's *Novelletten-Bibliothek*, II. (2)

*English.*—American literature. (2) Essays.

## SECOND TERM.

*Mathematics.*—Differential and integral calculus. (4)

*Mechanics.*—Theory of motion, statics, energy, center of gravity, moment of inertia, and general equations of motion. (2)

*Physics.*—Heat, magnetism, electricity, and light. Lectures. (2) Laboratory. (1)

*Steam Engine.*—Holmes' *Steam Engine*. (4)

*German.*—Grammar. Riehl: *Culturgeschichtliche Novellen*. Freytag: *Aus dem Staat Friedrichs des Grossen*. Dictation. (2)

*English.*—English prose literature. (2) Essays.

## JUNIOR CLASS.

### FIRST TERM.

*Mathematics.*—Calculus and mechanics. (2)

*Strength of Materials.*—Elasticity and strength of wood, stone, and metals. Theory of beams, columns, and shafts. Reports on experimental tests. (4)

*Mechanics of Machinery.*—Hermann-Smith. *Graphical Statistics of Mechanisms*. (2)

*Mechanical Technology.*—Shop instruction. Examination of the processes and appliances involved in pattern-making, moulding, forging, fitting, and finishing, with sketches and reports. (5)

*Boilers.*—Wilson. Strength, construction, and wear and tear of boilers. (1)

*German*.—Lessing, Herder, Goethe, Schiller, Heine, etc. Dictation. Compositions. (2) Conversation class optional throughout the year.

*English*.—English and American Orators. (1)

#### SECOND TERM.

*Kinematics of Machinery*.—Nature and equivalence of mechanisms. Diagrams of the changes of position, speed, and acceleration in mechanisms. Valve and link motions. (6)

*Machine Design*.—Calculations and working drawings for a high-speed steam engine. (5)

*Machinery of Transmission*.—Weisbach-Herrmann. (3)

*German*.—Readings. Compositions. Lectures on German literature. (1) Technical readings. (1)

*English*.—British Essayists. (1)

#### SENIOR CLASS.

##### FIRST TERM.

*Thermodynamics*.—General principles; application to steam engines and air compressors. (3)

*Graphical Statics*.—Graphical analysis of roof trusses and girders. (2)

*Machine Design*.—Calculations and working drawings for hoisting, pumping, and metal-working machinery. (3)

*Metallurgy*.—Metallurgical processes. Furnaces. Refractory building materials. Combustion. Natural and artificial fuels. Metallurgy of iron. (5)

*Measurement of Power*.—Indicating of steam engines; determination of evaporative efficiency of boilers; dynamometer experiments. (1)

*Mechanics of Machinery*.—Weisbach-Herrmann. Hoisting machinery, accumulators, cranes, and locomotives. (2)



## SECOND TERM.

*Mechanics of Machinery.*—Weisbach-Herrmann. Pumps, pumping engines, blowing engines, compressors, and fans. (4)

*Machine Design.*—Original designs. (5)

*Hydraulics.*—Hydrostatics. Flow of water in pipes and channels. Hydraulic motors. (3)

*Measurement of Power.*—Indicating of steam engines; determination of evaporative efficiency of boilers; dynamometer experiments. (1)

*Christian Evidences.*—Lectures. (1)

*Preparation of Thesis.*

## THE COURSES IN MINING ENGINEERING.

These courses aim to fit the student for practical work in either of the branches of mining, metallurgy, metallurgical chemistry, or geology. On account of the great number and scope of the studies necessary to the attainment of the degree of Engineer of Mines (E.M.), which includes that of Metallurgist, five years are required. At the end of the fourth year the student will have completed a course similar to that leading to the scientific degree in other institutions, and will receive the degree of Bachelor of Science (B.S.). On completing the first year, those who desire to practice mining alone are provided with a special course leading to the degree of Bachelor of Science (B.S.) in mining. The following program of subjects and studies shows the requirements for the degree of Engineer of Mines.

**MODERN LANGUAGES.**—Although the option of studying French or German lies with the student, it may be well to note that the current literature of the subjects taught in these courses is more abundant in the latter language.

**DRAWING AND CONSTRUCTION.**—The course in mechanical drawing begins with tracings of good examples of machine drawings; then follow the interpretation of such drawings, and the making of general views of machines from detailed sketches, exercises in projection drawing from the same, and the proportioning of simple tools and machines.

A brief course in descriptive geometry is given, in which the student is grounded in the fundamental principles of the subject. The simpler applications are given in the form of problems, and a number of practical examples are worked out in the drawing room.

Under the charge of an instructor, the students make visits of inspection to mines and metallurgical works, during which they examine and make sketches of portions of the plant, and take notes concerning it. From these sketches and notes they subsequently make working drawings accompanied by written memoirs explanatory of the construction and operation of the plant.

In a later portion of the course, the students are required to make original designs for mining and metallurgical plant under given conditions, involving exercise in the adaptation and proportioning of structures, machinery, and apparatus to suit the conditions given.

The field work in mining and geological surveying is followed by map construction from field notes.

**CHEMISTRY.**—The course in theoretical and applied chemistry extends over three years and includes work in wet and dry assaying of all the important ores and metallurgical products met with in actual practice, combined with the working of stoichiometric problems and the study of chemical philosophy. The practical work is that required for a metallurgical chemist or assayer.

With moderate care the expenses in this department need not exceed \$120.

**MINERALOGY.**—This subject is divided into two courses. In the first course, after a short exposition of the laws of

crystallography and a description of crystalline forms, practical exercises are held in the determination of simple and complex crystals, in which the student is taught to identify the various crystalline forms observed in minerals by the aid of models and of actual crystals, and with the use of the application goniometer. The second course includes the subjects of physical, descriptive, and determinative mineralogy. As in the first course, the greater part of the time is devoted to practical exercises, which, in this course, have for their object the determination of minerals. Each student is thus enabled to become familiar with the more common minerals by the actual handling of several hundred specimens, with the facility of making such tests as will not injure them. The presence of one or more instructors during each exercise permits the student to make frequent reports of his determinations, and to receive much instruction as to the characteristics of the minerals. The knowledge thus acquired can be supplemented by visits to the museum.

The course in blowpipe analysis may be considered as auxiliary to the practical exercises in determinative mineralogy. In the latter the student is urged to rely chiefly on physical tests; in the former he is required to determine minerals by the aid of the blowpipe.

The mineralogical laboratory offers facilities for an advanced course in crystallography and in physical and microscopic mineralogy to a few students who may receive permission to pursue such a course.

**GEOLOGY.**—This subject is studied with special reference to the needs of the mining engineer. Within a radius of twenty miles the student meets and becomes acquainted with the rocks of the archæan, the palæozoic, and the mesozoic formations, and makes geological maps from his own field notes, paying attention to the lithological characters of the formations, as they are mainly non-fossiliferous south of the Blue Ridge. An extended practical course in lithology familiarizes the student with the rocks of importance to the mining engineer and enables him to determine them

by sight. There are over 2500 specimens in the collections, embracing nearly all the known species. The course in historic geology is illustrated by a cabinet of typical specimens. The course in economic geology supplements the above work by familiarizing the student with the geological horizon of all the valuable constituents of the earth's crust and the theories of their formation. As Bethlehem is near the center of the "extra-moraine" drift, exceptional facilities are afforded for the study of pleistocene geology in Eastern Pennsylvania.

**ASTRONOMY.**—After studying the theory of the subject two-thirds of the year are devoted to practical work in the observatory.

**APPLIED MECHANICS.**—This embraces hydraulics, a study of the steam engine, and the mechanics of machines employed in mining and metallurgy.

**SURVEYING.**—A course extending over five terms offers practice in land, mine, and geological surveying, leveling, topography, triangulation, railroad reconnaissance and location, and the use of the solar transit. It also includes practical work in drawing and map construction.

**METALLURGY.**—There are two courses, making, together, about one hundred and forty lectures on this subject, which extend throughout a year. In these the chief object kept in view is a clear presentation of the principles involved in the various metallurgical processes, looked upon as the application to practice of the laws of chemistry, physics, and mechanics. This is followed, in the case of each process, by a description of the more important examples of the plant and of the methods of conducting the process, and by indications concerning its economic features. In order to ensure the student's understanding the fundamental principles of metallurgy, and his becoming so familiar with them as to be able readily to apply them, he is required to solve a series of problems in which these

principles are involved. Many of the problems are such as are likely to present themselves to the metallurgist in his current practice.

The metallurgical laboratory affords opportunity for special investigations in subjects connected with metallurgy to such advanced students as are competent to conduct them.

**MINING.**—This subject is covered by three courses. The first begins with the application of economic geology to the needs of the engineer, so that he can study and value mining properties, locate appropriately the necessary plant, and calculate the cost of production. It includes the discussion of faults and the means of finding faulted bodies, with practical problems. The subjects of blasting, timbering, and winning deposits are applied to actual cases, as tunnel-driving, etc., and problems from practical data are solved by the students. The second course covers the subjects of underground and surface haulage; loading, unloading, and stocking ores; pumping; ventilation; hygiene and mining law. A series of problems is given in each of these subjects to cover cases that meet the engineer in ordinary practice. The third course treats of the mechanical preparation of ores by the wet, dry, or magnetic methods, and especially of the preparation of anthracite coal.

The location of the University in the vicinity of the iron works of the Lehigh Valley, and especially of the extensive establishment of the Bethlehem Iron Company, affords unusual facilities for the practical study of iron metallurgy. The processes for the manufacture of spelter and oxide of zinc may be studied at the Bethlehem Zinc Works. The facilities for the practical study of mining and economic geology are not excelled by those of any other institution in the country. The zinc mines at Friedensville, the paint ores of the Marcellus formation, and the brown hematite and slate deposits of the Lehigh Valley are in the immediate vicinity, while within easy reach by rail are the semi-bituminous and anthracite coal fields, the block and fossil iron ores of the Clinton measures, the iron mines at Corn-

wall, Pennsylvania, and the iron and zinc mines of New Jersey; together affording examples of nearly all the methods of winning and dressing valuable deposits. Numerous visits of inspection are made in connection with the work of the course, to familiarize the student with metallurgical and mining processes and afford data for practical examples and projects.

### THE COURSE IN MINING ENGINEERING.

This course is arranged so that the subjects which prepare the student for practice in the field of metallurgy shall be completed at the end of four years, when the graduate will receive the degree of Bachelor of Science in Metallurgy (B.S.). By remaining a year longer, and taking the subjects laid down for the graduate year, the graduate in the course may obtain the degree of Engineer of Mines (E.M.).

#### FRESHMAN CLASS.

##### FIRST TERM.

*See page 48.*

##### SECOND TERM.

*Mathematics.*—Algebra. (3) Plane and spherical trigonometry and mensuration. Use of logarithmic tables. (2)

*Chemistry.*—Lectures and laboratory practice. Douglas and Prescott's Qualitative Analysis. (5)

*Stoichiometry.* (2)

*French.*—Grammar and reader (continued). (3) *German.*—Grammar and reader (continued). Bernhardt's *Novellen-Bibliothek*, I. (3)

*English.*—History of the English language. (2) Essays.

#### SOPHOMORE CLASS.

##### FIRST TERM.

*Mathematics.*—Analytical geometry. (5)

*Physics.*—Heat, magnetism, and electricity. Lectures, with study of text-book. (2) Laboratory. (2)

*Drawing*.—Tracings and blue prints. Sketches and working drawings of machine pieces. Interpretation of drawings by isometric sketches. General views from given details. Sections of simple construction. Intersections of spheres, cones, cylinders, etc., accompanying the study of descriptive geometry and illustrated from examples of mining and metallurgical plant. (4)

*French*.—Grammar. George Sand : *La Mare au Diable*. Dumas: Pauline. (2) Or *German*.—Grammar. Bernhardt's *Novelletten-Bibliothek*, II. (2)

*English*.—American literature. (2) Essays.

#### SECOND TERM.

*Mathematics*.—Differential and integral calculus. (4)

*Mechanics*.—Theory of motion, statics, energy, center of gravity, moment of inertia, and general equations of motion. (2)

*Physics*.—Heat, magnetism, electricity, and light. Lectures. (2) Laboratory. (1)

*Drawing*.—Flat tinting with water colors. Graphical problems illustrating the direction and extent of throw in faults. Examination and sketching of metallurgical plant in the vicinity. General views and working drawings of the plant examined, accompanied by written descriptions of its construction and operation. (4)

*French*.—Grammar. Vigny : *Le Cachet Rouge*. Hugo : *La Chute*. Dictation. (2) Or *German*.—Grammar. Riehl: *Culturgeschichtliche Novellen*. Freytag : *Aus dem Staat Friedrichs des Grossen*. Dictation. (2)

*English*.—English prose literature. (2) Essays.

#### JUNIOR CLASS.

##### FIRST TERM.

*Mathematics*.—Calculus and mechanics. (2)

*Strength of Materials*.—Elasticity and strength of wood, stone, and metals. Theory of beams, columns, and shafts. Reports on the testing of materials. (4)

*Crystallography*.—Lectures, with practical exercises in the determination of crystals. (2)

*Chemistry*.—Fresenius' Quantitative Analysis. (3) The following analyses are executed by the student:

1. Iron wire (Fe).
2. Copper ore (Cu).
3. Silver coin (Au, Ag, Pb, Cu).
4. Zinc ore (Zn). By both gravimetric and volumetric methods.
5. Bronze (Cu, Sn, Zn, Pb).
6. Spiegeleisen (Mn).

*Chemical Philosophy*.—Tilden. Chemical calculations. Whiteley. (3)

*French*.—Corneille, Racine, Molière, Hugo, etc. Dictation. Compositions. (2) Or *German*.—Lessing, Herder, Goethe, Schiller, Heine, etc. Dictation. Compositions. (2)

Conversation class in both languages optional throughout the year.

*English*.—English and American Orators. (1)

## SECOND TERM.

*Mineralogy*.—Descriptive mineralogy, with practical exercises in the determination of minerals: E. S. Dana. (3)

*Blow-Pipe Analysis*.—Lectures, with practice. Plattner, Brush, or Nason and Chandler. (1)

*Chemistry*.—Quantitative analysis: laboratory work: Fresenius. (3) The following analyses are executed by the student:

7. Lead ore (Pb, S).
8. Ilmenite ( $\text{TiO}_2$ ).
9. Iron ore (complete analysis).
10. Limestone (complete analysis).
11. Coal (volatile matter, fixed carbon, ash,  $\text{H}_2\text{O}$ , S, P).

*Steam Engine*.—Holmes' Steam Engine. (4)

*Land Surveying*.—Theory and use of level and transit. Field practice and map drawing. (2)



*French or German.*—Readings. Compositions. Lectures on French or German literature. (1) Technical readings. (1)

*English.*—British Essayists. (1)

#### SENIOR CLASS.

##### FIRST TERM.

*Metallurgy.*—Metallurgical processes. Furnaces. Refractory building materials. Combustion. Natural and artificial fuels. Metallurgy of iron. (5)

*Blow-Pipe Analysis.*—Practice. (1)

*Lithology.*—Williams' Lithology, with practical exercises in determining rocks. (3)

*Mechanics of Machinery.*—Herrmann-Smith. The graphical statics of mechanisms. (2)

*Assaying.*—Including the assay by the dry methods of gold, silver, antimony, lead, iron, and tin ores, coal, and gold and silver bullion. Laboratory work. Ricketts. (3)

*Chemistry.*—Quantitative analysis: laboratory work: Fresenius. (2) The following analyses are executed by the student:

12. Slag (complete analysis).
13. Pig iron (complete analysis).
14. Carbon in steel (volumetric).
15. Nickel ore (Ni, Co).
16. Gas analysis.

*Measurement of Power.*—Indicating of steam engines; determination of evaporative efficiency of boilers; dynamometer experiments. (1)

##### SECOND TERM.

*Mining.*—Mechanical preparation of ores. Coal washing. Lectures. (2)

*Metallurgy.*—Of copper, lead, silver, gold, &c. (4)

*Drawing.*—Designing of furnaces and other metallurgical plant. (2)

*Mechanics of Machinery.*—Hoisting machinery, accumulators, pumps, pumping-engines, blowing-engines, compressors, and fans. (4)

*Hydraulics.*—Hydrostatics. Flow of water in pipes and channels. Hydraulic motors. (3)

*Christian Evidences.*—Lectures. (1)

*Preparation of Thesis.*

*Gymnasium.*

#### GRADUATE YEAR.

##### FIRST TERM.

*Mining.*—Underground transportation. Hoisting, drainage, and pumping. Ventilation and lighting. Hygiene of mines. Mining law. Lectures. (4)

*Geology.*—General geological definitions and principles. Dynamic geology. Dana. (2)

*Drawing.*—General views of mining plant and detailed sketches. (3)

*Astronomy.*—Young's General Astronomy. (3)

*Topographic Surveying.*—Field work, with transit and stadia, and with plane table. Topographical maps. (3)

*Mine Surveying.*—Theory and problems. (1)

##### SECOND TERM.

*Geology.*—Historic geology. Dana. (2)

*Projects.*—In geology and mining. Designing of mining plant. (3)

*Mining.*—Prospecting. Economic geology. Boring. Valuation of property. Methods of mining. Lectures. (4)

*Mine Surveying.*—Practice, with construction of mine maps. (1)

*Railroad Surveying.*—Theory of railroad curves. Railroad reconnaissance and location. Survey of a line, with profile, map, and estimate of cost. (4)

*Astronomy.*—Doolittle's Practical Astronomy, with observatory work. (2)

*Preparation of Thesis.*

## THE SHORTER COURSE IN MINING.

This course is so designed that the student who desires to pursue the practice of mining and ore-dressing, and who does not wish to take the full course, may be prepared for practice in four years, receiving the degree of Bachelor of Science in Mining (B.S.).

For such students as may take the surveying of second term sophomore year in the summer school at the end of freshman year, or that of first term junior year at the end of sophomore year, or both, advanced work will be provided in such subjects as may be agreed upon by the student and the professor in charge of the department.

## FRESHMAN CLASS.

## FIRST TERM.

*See page 48.*

## SECOND TERM.

*Mathematics.*—Algebra. (3) Plane and spherical trigonometry and mensuration. Use of logarithmic tables. (2)

*Chemistry.*—Lectures and laboratory practice. Douglas and Prescott's Qualitative Analysis. (3)

*Drawing.*—Tracings and blue prints. Sections of simple construction. Intersections of spheres, cones, cylinders, etc., illustrated from examples of mining and metallurgical plant. (4)

*French.*—Grammar and reader (continued). (3) Or *German.*—Grammar and reader (continued). Bernhardt's Novellen-Bibliothek, I. (3)

*English.*—History of the English language. (2) Essays.

## SOPHOMORE CLASS.

## FIRST TERM.

*Mathematics.*—Analytical geometry. (5)

*Drawing.*—Sketches and working drawings of machine pieces. Interpretation of drawings by isometric sketches.

General views from given details. Graphical problems illustrating the direction and extent of throw in faults. (2)

*Physics*.—Heat, magnetism, and electricity. Lectures, with study of text-book. (2) Laboratory. (2)

*Crystallography*.—Lectures, with practical exercises in the determination of crystals. (2)

*French*.—Grammar. George Sand: *La Mare au Diable*. Dumas: *Pauline*. (2) Or *German*.—Grammar. Bernhardt's *Novelletten-Bibliothek*, II. (2)

*English*.—American literature. (2) Essays.

## SECOND TERM.

*Mathematics*.—Differential and integral calculus. (4)

*Mechanics*.—Theory of motion, statics, energy, center of gravity, moment of inertia, and general equations of motion. (2)

*Mineralogy*.—Descriptive mineralogy, with practical exercises in the determination of minerals: E. S. Dana. (3)

*Land Surveying*.—Theory and use of level and transit. Field practice and map-drawing. (2)

*Blow-Pipe Analysis*.—Lectures, with practice. Plattner, Brush, or Nason and Chandler. (1)

*French*.—Grammar. Vigny: *Le Cachet Rouge*. Hugo: *La Chute*. Dictation. (2) Or *German*.—Grammar. Riehl: *Culturgeschichtliche Novellen*. Freytag: *Aus dem Staat Friedrichs des Grossen*. Dictation. (2)

*English*.—English prose literature. (2) Essays.

## JUNIOR CLASS.

### FIRST TERM.

*Mathematics*.—Calculus and mechanics. (2)

*Strength of Materials*.—Elasticity and strength of wood, stone, and metals. Theory of beams, columns, and shafts. Reports on the testing of materials. (4)

*Geology*.—General geological definitions and principles. Dynamic geology. Dana. (2)

*Lithology*.—Williams' *Lithology*, with practical exercises in determining rocks. (3)

*Topographic Surveying.*—Field work with transit and stadia, and with plane table. Topographical maps. (4)

*French.*—Corneille, Racine, Molière, Hugo, etc. Dictation. Compositions. (2) Or *German.*—Lessing, Herder, Goethe, Schiller, Heine, etc. Dictation. Compositions. (2) Conversation class in both languages optional throughout the year.

*English.*—English and American orators. (1)

#### SECOND TERM.

*Geology.*—Historic geology. Lectures. Dana. (2)

*Mining.*—Prospecting. Economic geology. Boring. Valuation of property. Timbering and walling. Support of excavations. Tunneling. Systems of mining. Lectures. (3)

*Steam Engine.*—Holmes' Steam Engine. (4)

*Railroad Surveying.*—Theory of railroad curves. Railroad reconnaissance and location. Survey of a line, with profile, map, and estimate of cost. (4)

*Physics.*—Heat, magnetism, electricity, and light. Lectures. (2) Laboratory. (1)

*French or German.*—Readings. Compositions. Lectures on French or German literature. (1) Technical readings. (1)

*English.*—British Essayists. (1)

#### SENIOR CLASS.

##### FIRST TERM.

*Mining.*—Underground transportation. Hoisting, drainage, and pumping. Ventilation and lighting. Hygiene of mines. Mining law. Lectures. (4)

*Physics.*—Electricity and magnetism. Lectures with recitations; text-book, Slingo and Brooker's Electrical Engineering. (3)

*Geodetic Surveying.*—Use of solar transit and sextant. Precise triangulation. Elements of geodesy. Determination of the systematic errors of instruments. (2)

*Assaying.*—Including the assay by the dry methods of gold, silver, antimony, lead, iron, and tin ores, coal, and gold and silver bullion. Laboratory work. Ricketts. (3)

*Mechanics of Machinery.*—Herrman-Smith. The graphical statics of mechanisms. (2)

*Mine Surveying.*—Theory, with problems in tunneling, shaft location, and survey of bore-holes. (1)

*Measurement of Power.*—Indicating of steam engines; determination of evaporative efficiency of boilers; dynamometer experiments. (1)

#### SECOND TERM.

*Mining.*—Mechanical preparation of ores. Coal washing. (2)

*Projects.*—In mining. Designing of mining plant. (4)

*Mechanics of Machinery.*—Hoisting machinery, accumulators, pumps, pumping-engines, blowing-engines, compressors, and fans. (4)

*Mine Surveying.*—Practice, with construction of mine maps. (1)

*Hydraulics.*—Hydrostatics. Flow of water in pipes and channels. Hydraulic motors. (3)

*Measurement of Power.*—Indicating of steam engines; determination of evaporative efficiency of boilers; dynamometer experiments. (1)

*Christian Evidences.*—Lectures. (1)

*Preparation of Thesis.*

*Gymnasium.*

#### THE COURSE IN PHYSICS AND ELECTRICAL ENGINEERING.

In the arrangement of the details of this course the object has been to provide for those who seek to fit themselves as Electrical Engineers a preliminary training as complete and broad as that given to the members of the other schools. The requirements for admission, the mathematical and English studies, the modern languages, and other outside branches are the same as those in the other technical courses. To these have been added such por-

tions of the other technical courses as are necessary to give the student a general but sufficiently accurate knowledge of all the allied subjects.

The main feature of the course is the prominence given to the subject of Physics. This extends through three years, and while Electricity is specially developed the other branches, Elementary Mechanics, Heat and Light, are fully provided for. The opportunity is thus given to any one who wishes to acquire a more extensive knowledge of Physics than the University curriculum has heretofore offered. The student is well drilled in the theory by means of lectures and recitations, which carefully cover the whole subject, and he is required to go over the ground himself in the best of all schools—the working laboratory. Enough work on each topic is given him to render him familiar with his subject. Much prominence is given to work that brings out the resources of the student himself, such as the construction of instruments and original investigation. He is encouraged to this and a regular portion of his time is set apart for this object.

It will be seen from the preceding statement that this course offers two great advantages: the thorough and extensive training of those intending to take part in the great development of Electric Science in the industrial field now going on and the facilities offered to those who wish to take a four years' course specially devoted to the whole subject of Physics.

The practical work of the Physical, the Electrical, and the Dynamo Laboratories, is too extensive to allow of full details being given in the following arrangement of the course. The more important subjects developed may be mentioned. In Mechanics, exact measurements, specific gravity, barometric leveling. In Heat, calorimetry and hygrometry. In Light, testing of optical instruments, spectroscopic analysis and photometry. In Magnetism, study of laws of force, determination of moments of magnets and of horizontal component of intensity of earth's magnetism in absolute units. Attention is also given in the Junior year, both in

lectures and laboratory work, to the investigation of the magnetic properties of iron, magnetic moment, intensity of magnetization, magnetic induction, permeability, susceptibility, hysteresis, etc. In Electricity, management of batteries, construction of instruments and their calibration, measurement of resistance and other electrical measurements, electrolysis and relation of electrical currents to heat and mechanical work; study of direct and alternating current dynamos and motors and practical running, care and tests for efficiency, etc.; a determination of the resistance, characteristics, and saturation curves, exploration of field, coefficient of magnetic leakage, etc.; electric lighting, with photometric tests of arc and incandescent lamps; measurement of heat units given off by lamps, their resistance (hot and cold); energy consumed in lamps; spectroscopic tests of purity of carbons; study of telegraph and telephone and of the application of electricity to street railways; visits to manufactories, working systems, electric railways, etc.

The work in Dynamo Design consists of a study of the principles of dynamo-electric machinery by lectures and recitations, and also of the practical calculation and design of dynamos for incandescent work, multipolar generators, stationary motors and street railway motors, alternate current apparatus, including generators, motors, and transformers. The design of street railway systems is also taken up, and long distance transmission of power. The preparation of the Thesis forms an important part of the work for the Senior year. It will consist of original investigation and research, in theoretical or applied electricity. The student is thrown upon his own resources as much as possible, and is made to rely on himself.

Through the generosity of members of the Board of Trustees, an important addition has been made to the apparatus of this department. It includes a 50 h. p. engine, an 80 cell storage battery, some machines for advanced alternating current work, a 2-phase alternator and motor, etc.; a lathe and workshop tools, and a number of standard



instruments of the finest kind for exact electrical measurements.

A deposit, varying in amount in the different laboratory rooms, but not exceeding \$25 for the year, is required from each student before he is allowed to work in any laboratory. From this, at the end of the year, is retained the cost of any material wasted or apparatus injured by him during the term.

The degree of Electrical Engineer (E. E.) will be given to the graduates of this course.

#### FRESHMAN CLASS.

##### FIRST TERM.

*See page 48.*

##### SECOND TERM.

*Mathematics.*—Algebra. (3) Plane and spherical trigonometry and mensuration. Use of logarithmic tables. (2)

*Chemistry.*—Lectures and laboratory practice. Douglas and Prescott's Qualitative Analysis. (3)

*Projection Drawing.*—Descriptive geometry and isometric drawing. Tracings and drawings of structures. (4)

*French.*—Grammar and reader (continued). (3) Or *German.*—Grammar and reader (continued). Bernhardt's *Novelletten-Bibliothek*, I. (3)

*English.*—History of the English language. (2) Essays.

#### SOPHOMORE CLASS.

##### FIRST TERM.

*Mathematics.*—Analytical geometry. (5)

*Physics.*—Heat. Magnetism and electricity. Lectures, with study of text-book. (2) Laboratory. (2)

*Machine Design.* (2)

*Chemistry.*—Fresenius's Quantitative Analysis. (2)

*French*.—Grammar. George Sand: *La Mare au Diable*. Dumas: *Pauline*. Or *German*.—Grammar. Bernhardt's *Novelletten-Bibliothek*, II. (2)

*English*.—American literature. (2) Essays.

#### SECOND TERM.

*Mathematics*.—Differential and integral calculus. (4)

*Mechanics*.—Theory of motion, statics, energy, center of gravity, moment of inertia, and general equations of motion. (2)

*Steam Engine*.—Holmes' *Steam Engine*. (4)

*Physics*.—Heat, magnetism, electricity, and light. Lectures. (2) Laboratory. (1)

*Chemistry*.—Lectures on Photography. (1)

*French*.—Grammar. Vigny: *Le Cachet Rouge*. Hugo: *La Chute*. Dictation. (2) Or *German*.—Grammar. Riehl: *Culturgeschichtliche Novellen*. Freytag: *Aus dem Staat Friedrichs des Grossen*. Dictation. (2)

*English*.—English prose literature. (2) Essays.

#### JUNIOR CLASS.

##### FIRST TERM.

*Mathematics*.—Calculus and mechanics. (2)

*Electricity*.—Ayrton's *Practical Electricity*. (2)

*Magnetism*.—Ewing's *Magnetic Induction in Iron*. (2)

*Electrical Laboratory*. (3)

*Strength of Materials*.—Elasticity and strength of wood, stone, and metals. Theory of beams, columns, and shafts. Reports on the testing of materials. (4)

*Boilers*.—Wilson. Strength, construction, and wear and tear of boilers. (1)

*French*.—Corneille, Racine, Molière, Hugo, etc. Dictation. Compositions. (2) Or *German*.—Lessing, Herder, Goethe, Schiller, Heine, etc. Dictation. Compositions. (2) Conversation class in both languages optional throughout the year.

*English*.—English and American Orators. (1)

## SECOND TERM.

*Dynamo-electric Machinery.*—S. P. Thompson's *Dynamo-electric Machinery.* (3)

*Alternating Currents.*—Bedell and Crehore's *Alternating Currents.* (3)

*Electrical Laboratory.* (3) Text-books recommended: Nichols's *Junior Course*, Fleming's *Forms*, Stewart and Gee's *Practical Physics.*

*Telegraphs and Telephones.*—Lectures. (3)

*Surveying.*—Theory and use of instruments. Location and construction of electric railways. (2)

*French or German.*—Readings. Compositions. Lectures on French or German literature. (1) Technical readings. (1)

*English.*—British Essayists. (1)

## SENIOR CLASS.

## FIRST TERM.

*Dynamo-electric Machinery.*—S. P. Thompson's *Dynamo-electric Machinery.* (2)

*Designing Room.* (3)

*Electric Light and Power.*—Lectures. (2)

*Dynamo Laboratory.* (3) Text-book recommended: Nichols's *Senior Course.*

*Measurement of Power.*—Indicating of steam engines and dynamometer experiments. (1)

*Mechanics of Machinery.*—Herrmann-Smith. The graphical statics of mechanisms. (2)

*Thermodynamics.* (3)

## SECOND TERM.

*Dynamo-electric Machinery.*—S. P. Thompson's *Polyphase Electric Currents and Kapp's Transformers.* (2)

*Designing Room.* (2)

*Dynamo Laboratory.* (3)

*Electro-metallurgy.* (1)

*Electric Railways.*—Recitations. Plans for an electric railway, with maps, specifications, etc. Long distance transmission of power. Text-book : Crosby and Bell's Electric Railways. (2)

*Hydraulics.*—Flow of water through orifices, pipes, and channels. Hydraulic motors. (3)

*Christian Evidences.* (1)

*Preparation of Thesis.*

### THE COURSE IN CHEMISTRY.

This course of study is designed to prepare students for the profession of the chemist, in connection with metallurgical establishments, sugar refineries, gas works, superphosphate works, electrical machinery manufactories, mining companies, etc., and the general consulting and analytical work of the professional chemist. It is also well adapted to the preparation of teachers of chemistry and as a course preliminary to the study of medicine. It is eminently practical, the student's time being largely occupied by practical work in the large, well equipped and well ventilated chemical laboratories, which were completed in 1885 and constitute the best constructed building for this purpose in this country. The museum of chemistry contains large collections of specimens, for illustrating the lectures on theoretical and applied chemistry.

**THEORETICAL CHEMISTRY.**—Instruction in this subject begins with lectures four times a week, in the first term of the Freshman year. These lectures are fully illustrated by experiments, colored diagrams, working drawings and lantern pictures, and specimens from the museum. They include a general introduction to theoretical chemistry, and a description of the non-metallic and metallic elements and their compounds, the general subject of inorganic chemistry. The students are required to take notes of the lectures, and to pass a written examination at the end of the term.

In the second term of this year stoichiometry and chemical problems and reactions are taught by recitations twice each week.

The study of theoretical chemistry is continued throughout the Sophomore year by recitations three times a week from Tilden's Chemical Philosophy, Whiteley's Chemical Calculations, and Remsen's Chemistry; in the first term of the Junior year, by a course of lectures and recitations on theoretical organic chemistry, four times a week and twice a week in the second term. These lectures are illustrated by experiments and by specimens from the museum of chemistry.

Written examinations are held at the close of each of the above courses.

ANALYTICAL CHEMISTRY.—Qualitative analysis is taught in the second term of the Freshman year, by lectures, recitations, and practical work in the qualitative laboratory, twelve hours of practical work per week being required. This laboratory is a large, well ventilated, and well lighted room, supplied with convenient working tables, vacuum filtration, hoods for noxious vapors, steam baths, gas and washing appliances, and a commodious room for hydrosulphuric acid. Distilled water is delivered by faucet in this room and the other large laboratories. At the close of the term a practical examination is held in this subject.

After completing this course, quantitative analysis is pursued throughout the Sophomore and the first term of the Junior years. This subject is taught by lectures, recitations, and practical work in the quantitative laboratory, which is equipped like the qualitative laboratory, but is supplied in addition with apparatus for drying precipitates and residues, rooms for the chemical balances, for combustions, and for a reference library.

Twelve hours per week are required during the first term of the Sophomore year and fifteen hours during the second term of that year and the first term of the Junior year.

The course consists in gravimetric and volumetric analyses, as applied to the substances given in the lists farther on, accuracy being required in the determination of each constituent.

At the close of each term written examinations are held upon the theory and practice of quantitative analysis.

GAS ANALYSIS is taught by lectures and laboratory practice in the gas laboratory. This laboratory is supplied with full and complete apparatus for gas analysis, according to Bunsen's processes, as well as apparatus for some of the more rapid methods. Mixtures of gases are required to be analyzed by the students, within certain limits of error, and a written examination, on the theory and practice, is held at the close of the course.

ASSAYING.—The assaying of ores by furnace assay, together with gold and silver bullion analysis, by processes practiced in the United States Mint, is taught by lectures and practical work in the first term of the Senior year, nine hours of practical work per week being required. The course includes the assaying of ores of lead, tin, antimony, gold, silver, and iron, coal, and gold and silver bullion.

The assaying laboratory is supplied with large working tables, twenty-nine crucible and two iron furnaces, and eight muffle furnaces, with adjoining rooms for balances, and gold and silver bullion analysis.

A certain accuracy of results and a written examination as regards theory and practice are required.

ORGANIC CHEMISTRY.—The practical work in this subject is performed in the second term of the Junior year, fifteen hours per week being required, with conferences and recitations each week. The laboratory for this work is equipped similarly to the quantitative laboratory, in addition being supplied with steam, cold water and air blast upon the working tables, and a full supply of apparatus for the various determinations and experiments, including com-

bustion furnaces, furnaces for heating sealed tubes, mercury pump, Hoffman's, Dumas' and Meyers' apparatus for vapor densities, nitrometers, chemical balances, etc.

The course consists of determinations of specific gravities, melting points, boiling points, vapor densities; chlorine, bromine, iodine, and sulphur of organic substances.

Combustion analysis, nitrogen determination, fractional distillation, and the preparation of fifty pure organic compounds and a number of analyses are included.

**INDUSTRIAL CHEMISTRY.**—A course of lectures is delivered upon this subject in the second term of the Senior year, illustrated by experiments, diagrams, lantern pictures, and specimens from the museum of chemistry. The working laboratories for this subject contain an apparatus for making illuminating gas, an alcohol still, worm and doubler, and a complete working model of a sugar refinery, including filters, vacuum pan, and centrifugal. There is also apparatus for use in the manufacture of chemicals, for dyeing, calico printing, and bleaching. In connection with these laboratories is a room containing a photometer and apparatus for determining the sulphur, ammonia, and specific gravity of illuminating gas; also a laboratory for the testing of alcoholic liquors, sugar, molasses, bone black, soap, petroleum, paints, dyes, superphosphates, tallow, illuminating and lubricating oils, rubber, explosives, paints, asphalts, and other commercial products, with the necessary technical apparatus. The students make practical experiments in this direction, and, with an instructor, visit various industrial establishments in this neighborhood and in and around New York City.

**TOXICOLOGY.**—A course of lectures on this subject is given in the first term of the Junior year, illustrated by experiments and by the large collection of specimens of poisons from the museum of chemistry. This is supplemented by a short course of laboratory work on some of the common poisons.

**SANITARY CHEMISTRY.**—During the second term of the Senior year attention is given to the qualitative and quantitative examination of air, water, food, disinfectants, baking-powders, flour, bread, tea, coffee, cocoa, spices, milk, butter, lard, beer, and other subjects connected with this branch of the science. Special apparatus is provided for this work, as recommended by the best authorities on the subject.

**PHOTOGRAPHIC CHEMISTRY.**—A well equipped photographic laboratory and dark rooms are provided, in which the students of the chemical course receive practical instruction.

**PHYSIOLOGICAL CHEMISTRY.**—The examination of urine, blood, organic and inorganic poisons, etc., receives a proper amount of attention.

The course also includes instruction in physics, mineralogy, blowpipe analysis, metallurgy, and geology, which are of great value to the chemist.

**MICROSCOPY.**—Instruction in the use of the microscope is given in the first term of the Senior year.

In the Senior year the student is required to prepare a thesis on some subject, selected by the Professor of Chemistry, involving practical work in the laboratory in addition to the literary labor, each graduate thus making a contribution to the progress of the science, as a preliminary to the reception of his degree.

The graduate of this course receives the degree of Analytical Chemist (A.C.).

Students, not candidates for a degree, are admitted to special courses in chemistry, of which they will receive certificates.

The laboratories are under the immediate charge of the Professor and Instructors of Chemistry and are open to the students from 8 o'clock A.M. to 6 o'clock P.M., including Saturdays. Students are at liberty to work in the laboratories beyond the required hours as their time may permit.



Students are charged for materials and apparatus consumed; with moderate care this expense need not exceed \$50 per year.

## FRESHMAN CLASS.

## FIRST TERM.

*See page 48.*

## SECOND TERM.

*Mathematics.*—Algebra. (3) Plane and spherical trigonometry and mensuration. Use of logarithmic tables. (2)

*Chemistry.*—Lectures and laboratory practice. Douglas and Prescott's Qualitative Analysis. (5)

*Stoichiometry.* (2)

*German.*—Grammar and Reader (continued). Bernhardt's Novelletten-Bibliothek, I. (3)

*English.*—History of the English language. (2) Essays.

## SOPHOMORE CLASS.

## FIRST TERM.

*Chemical Philosophy.* — Tilden. Chemical calculations. Whiteley. (3)

*Quantitative Analysis.*—Fresenius' Quantitative Analysis. (5)

The following analyses are executed by the student:

1. Iron wire (Fe).
2. Potassium dichromate ( $\text{Cr}_2\text{O}_3$ ).
3. Barium chloride ( $\text{Ba}$ ,  $\text{Cl}$ ,  $\text{H}_2\text{O}$ ).
4. Magnesium sulphate ( $\text{MgO}$ ,  $\text{SO}_3$ ,  $\text{H}_2\text{O}$ ).
5. Disodium hydrogen phosphate ( $\text{P}_2\text{O}_5$ ).
6. Rochelle salt ( $\text{K}_2\text{O}$ ,  $\text{Na}_2\text{O}$ ).
7. Volumetric determination of chlorine.
8. Acidimetry ( $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ ).
9. Alkalimetry ( $\text{KOH}$ ,  $\text{NaOH}$ ,  $\text{NH}_4\text{OH}$ , soda ash, pearl ash).
10. Chlorimetry (bleaching powders).

*Quantitative Analysis*.—Conference. (1)

*Physics*.—Heat, magnetism, and electricity. Lectures, with study of text-book. (2) Laboratory. (2)

*German*.—Grammar. Bernhardt's *Novelletten-Bibliothek*, II. (2)

*English*.—American literature. (2) Essays.

## SECOND TERM.

*Physics*.—Heat, magnetism, electricity, and light. Lectures. (2) Laboratory. (1)

*Quantitative Analysis*.—Fresenius' *Quantitative Analysis*. (5)

The following analyses are executed by the student:

11. Copper ore (Cu).

12. Zinc ore (Zn). By both gravimetric and volumetric methods.

13. Lead ore (Pb, S).

14. Silver coin (Au, Pb, Ag, Cu).

15. Spiegeleisen (Mn).

16. Copper alloys (complete analysis).

17. Ilmenite ( $\text{TiO}_2$ ).

18. Iron ore (complete analysis).

19. Limestone (complete analysis).

20. Coal (volatile matter, fixed carbon, ash,  $\text{H}_2$ , O, S, P).

21. Slag (complete analysis).

*Quantitative Analysis*.—Conference. (1)

*Chemistry*.—Remsen. Advanced course. (3)

*German*.—Grammar. Riehl: *Culturgeschichtliche Novellen*. Freytag: *Aus dem Staat Friedrichs des Grossen*. Dictation. (2)

*English*.—English prose literature. (2) Essays.

## JUNIOR CLASS.

### FIRST TERM.

*Toxicology*.—Lectures. (2)

*Quantitative Analysis*.—Fresenius' *Quantitative Analysis*. (5)

The following analyses are executed by the student :

22. Guano ( $\text{NH}_3$ ,  $\text{P}_2\text{O}_5$ ,  $\text{H}_2\text{O}$ ).
23. Clay (complete analysis).
24. Manganese ore ( $\text{MnO}_2$ ).
25. Mineral water (complete analysis).
26. Pig iron (complete analysis).
27. Nickel ore ( $\text{Ni}$ ,  $\text{Co}$ ).
28. Carbon in steel (volumetric).
29. Gas analysis.

*Quantitative Analysis*.—Conference. (1)

*Organic Chemistry*.—Lectures and recitations. (4)

*Crystallography*.—Lectures, with practical exercises in the determination of crystals. (2)

*German*.—Lessing, Herder, Goethe, Schiller, Heine, etc. Dictation. Compositions. (2) Conversation class optional throughout the year.

*English*.—English and American Orators. (1)

#### SECOND TERM.

*Organic Chemistry*.—Laboratory. (6)

*Organic Chemistry*.—Conference. (1)

*Metallurgy*.—Of copper, lead, silver, gold, etc. (5)

*Mineralogy*.—Descriptive mineralogy, with practical exercises in the determination of minerals. E. S. Dana. (3)

*Blow-Pipe Analysis*.—Lectures, with practice. Plattner, Brush, or Nason and Chandler. (1)

*German*.—Readings. Compositions. Lectures on German literature. (1) Technical readings. (1)

*English*.—British Essayists. (1)

#### SENIOR CLASS.

##### FIRST TERM.

*Metallurgy*.—Metallurgical processes. Furnaces. Refractory building materials. Combustion. Natural and artificial fuels. Metallurgy of iron. (4)

*Assaying*.—Including the assay by the dry method of gold, silver, antimony, lead, iron, and tin ores, coal, gold and silver bullion, and rich lead. Ricketts. (3)

*Industrial Chemistry*.—Laboratory. (3)

*Geology*.—Williams' Lithology, with practical exercises in determining rocks. (3)

*Microscopy*.—Laboratory. (2).

*Blow Pipe Analysis*.—Practice. (1)

*Preparation of Thesis*.

#### SECOND TERM.

*Industrial Chemistry*.—Lectures. (3)

*Industrial Chemistry*.—Laboratory. (3)

*Industrial Chemistry*.—Conference. (1)

*Agricultural Chemistry*.—Laboratory. (1)

*Sanitary Chemistry*.—Laboratory. (1)

*Geology*.—Historic and dynamic geology. Lectures. LeConte. (3)

*Christian Evidences*.—Lectures. (1)

*Preparation of Thesis*. (4)

#### THE COURSE IN ARCHITECTURE.

The studies in this course are closely allied with those in civil engineering, the higher surveying, railroad work, mineralogy, geology, and astronomy being omitted; instead of which architectural designing is substituted, as seen in the following program. Instruction is also given in the history and æsthetics of architecture, in methods of heating and ventilating, in boilers and hoisting machinery, and in house drainage and sewerage.

During the first and second years the student lays the foundation for his professional work by the study of mathematics, physics, mechanics, drawing, surveying, English, and French or German. The course in drawing includes the use of water colors, free-hand, projection and isometric drawing, and their application to the general plans for masonry structures. In surveying there is field practice in the use of instruments, and also map drawing, thus enabling the student to understand the application

of the subject to landscape gardening, and to the location of buildings.

During the third and fourth years of the course the work is of a more professional character. The subject of construction familiarizes the student with brick, stone, cement, and other materials, with foundations and masonry, with arches, piers, and walls, and with the stone-cutter's art. There is a full course in the theory and calculation of columns, beams, and shafts, in the strength of materials and its application to roof trusses and bridges. Working drawings of arches, piers, and roof trusses are made in detail. Plans and estimates are prepared for wooden, brick, stone, and iron buildings, the work being done according to standard specifications. In connection with the course visits of inspection are made to engineering structures in the Lehigh Valley and vicinity.

The student who completes all the subjects of this course will receive the degree of Bachelor of Science in Architecture (B. S.).

#### FRESHMAN CLASS.

##### FIRST TERM.

*See Page 48.*

##### SECOND TERM.

*Mathematics.*—Algebra. (3) Plane and spherical trigonometry and mensuration. Use of logarithmic tables. (2)

*Construction.*—Materials. Masonry. Carpentry. Roads and pavements. Sketches of structures. (2)

*Projection Drawing.*—Descriptive geometry and isometric drawing. Tracings and drawings of structures. (4)

*French.*—Grammar and Reader (continued). (3) Or *German.*—Grammar and Reader (continued). Bernhardt's *Novellen-Bibliothek*, I. (3)

*English.*—History of the English language. (2) Essays.

## SOPHOMORE CLASS.

## FIRST TERM.

*Mathematics.*—Analytical geometry. (5)

*Physics.*—Heat, magnetism, and electricity. Lectures, with study of text-book. (2) Laboratory. (2)

*Architectural Drawing.*—Plans of piers and arches. Problems in stone cutting. Use of water colors. (3)

*French.*—Grammar. George Sand: *La Mare au Diable*. Dumas: *Pauline*. (2) Or *German.*—Grammar. Bernhardt's *Novelletten-Bibliothek*, II. (2)

*English.*—American literature. (2) Essays.

## SECOND TERM.

*Mathematics.*—Differential and integral calculus. (4)

*Mechanics.*—Theory of motion, statics, energy, center of gravity, moment of inertia, and general equations of motion. (2)

*Physics.*—Heat, magnetism, electricity, and light. Lectures. (2) Laboratory. (1)

*Surveying.*—Theory and use of compass, level, and transit. Surveys and maps of farms. Leveling. (4)

*French.*—Grammar. Vigny: *Le Cachet Rouge*. Hugo: *La Chute*. Dictation. (2) Or *German.*—Grammar. Riehl: *Culturgeschichtliche Novellen*. Freytag: *Aus dem Staat Friedrichs des Grossen*. Dictation. (2)

*English.*—English prose literature. (2) Essays.

## JUNIOR CLASS.

## FIRST TERM.

*Mathematics.*—Calculus and mechanics. (2)

*Strength of Materials.*—Elasticity and strength of wood, stone, and metals. Theory of beams, columns, and shafts. Work in the testing laboratory. (4)

*Construction.*—Foundations, arches, dams, walls, and bridges. Visits of inspection. (3)

*Perspective Drawing.*—Shades, shadows, and linear perspective. Pen and ink rendering. (4)

*French.*—Corneille, Racine, Molière, Hugo, etc. Dictation. Compositions. (2) Or *German.*—Lessing, Herder, Goethe, Schiller, Heine, etc. Dictation. Compositions. (2) Conversation class in both languages optional throughout the year.

*English.*—English and American Orators. (1)

## SECOND TERM.

*Roofs and Bridges.*—Theory and calculation of stresses in roof and bridge trusses. (4)

*Sanitary Engineering.*—Collection, purification, and distribution of water. Systems of water supply and sewerage. Drainage and sewerage of buildings. (3)

*Architecture.*—Designs and estimates for brick and stone buildings. (4)

*History.*—The history and styles of architecture. (2) Lectures on Roman antiquities. (1)

*French or German.*—Readings. Compositions. Lectures on French or German literature. (1) Technical readings. (1)

*English.*—British Essayists. (1)

## SENIOR YEAR.

### FIRST TERM.

*Roofs and Bridges.*—Graphic statics. Designs for plate girders, riveted and pin-connected roof trusses, with working drawings. (7)

*Mechanics of Machinery.*—Pile drivers, cranes, and elevators. (2)

*Boilers.*—Strength, construction, and wear and tear of boilers. Wilson. (1)

*Architecture.*—Specifications and estimates. Design for an iron building. (4)

*Heating and Ventilation.*—Systems of heating, lighting, and ventilating buildings. (2)

#### SECOND TERM.

*Hydraulics.*—Efflux of water from orifices, and flow in pipes and channels. Hydraulic motors. (3)

*Roofs and Bridges.*—Theory of cantilever, draw, continuous, and arched structures. (3)

*Architecture.*—Building superintendence. The æsthetics of architecture. Plans, specifications. (6)

*Christian Evidences.*—Lectures. (1)

*Preparation of Thesis.* (3)

#### PHYSICAL CULTURE.

The Gymnasium is open morning, afternoon, and evening; in all, 45 hours a week. Exercise in it is required of all students who are fitted to take it. Class drill with the Instructor and individual exercise are prescribed.

#### GRADUATING THESES.

Every student will be required to present a thesis upon some topic connected with his special course, as a necessary portion of the exercises for his final examination for a diploma. These theses shall be accompanied by drawings and diagrams, when the subjects need such illustration. The originals will be kept by the University, as a part of the student's record, for future reference; but a copy may be retained by the student, and be published, permission being first obtained from the President.

#### DIPLOMAS AND CERTIFICATES.

The Diploma is given only to those who have passed all the examinations in a regular course and is signed by the Secretary of the Board of Trustees and by the Faculty of the University. For all the partial courses a certificate is given, signed by the Secretary of the Faculty, and showing what the student has accomplished.



## GRADUATE STUDENTS.

Graduate students wishing to remain a year or more and pursue a course of study as candidates for another Degree may do so with the sanction of the Faculty. Those wishing to take *special* courses of study will be afforded every facility for so doing.

## GRADUATE DEGREES.

## M. A.

The Faculty will recommend for the Degree of Master of Arts any candidate, otherwise properly qualified, who, after taking at this University the Degree of Bachelor of Arts, shall pursue, for at least one year at this University, or two years elsewhere, a course of liberal study prescribed by the Faculty in at least two departments (under at least two professors), pass a thorough examination in the same, and present a satisfactory Thesis.

## M. S.

The Faculty will recommend for the Degree of Master of Science any candidate, otherwise properly qualified, who, after taking at this University any Degree in the School of Technology, shall pursue, for at least one year at this University, a course of study prescribed by the Faculty in at least two departments (under at least two professors), pass a thorough examination in the same and present a satisfactory Thesis. Graduates of the Latin-Scientific Course, or of that of Science and Letters, are permitted to study *in absentia* for the degree of M.S., subject to the same restrictions as those prescribed for candidates for the degree of M.A.

The Theses presented by candidates for Graduate Degrees shall be retained by the University.

Applicants for either of these degrees will be required to complete the prescribed work within the allotted time. Special action of the Faculty is required for any extension of time.

## THE UNIVERSITY LIBRARY.

The Library building was erected by the Founder of the University in 1877, at a cost of \$100,000, as a memorial of his daughter, Mrs. Lucy Packer Linderman, and during the same year more than \$20,000 were contributed by her family and friends as a memorial fund for the purchase of books. By the will of the Founder of the University a fund of \$500,000 has been given for the permanent endowment of the library.

The building is semi-circular in plan, with a handsome façade in the Venetian style of architecture. It is constructed of Potsdam sandstone with granite ornamentation. In the interior, the center is occupied as a reading space, fifty by forty feet, from which radiate the book cases, extending from floor to ceiling; two galleries affording access to the upper cases. Shelf room is now provided for one hundred and sixty thousand volumes. The building is thoroughly fireproof, well lighted, and heated by steam.

Ninety-seven thousand volumes are now upon the shelves, including many extremely valuable works. The list of periodicals numbers about two hundred and fifty, embracing as far as possible all departments of knowledge.

The Library is conducted strictly for consultation, and is open to the use of the public; both of which conditions are in accord with the terms of the gift.

## REGULATIONS OF THE LEHIGH UNIVERSITY LIBRARY.

- I. The Library is open every day, except Sundays and Legal Holidays, from 8 A.M. until 10 P.M., and on Sundays for the students and others connected with the University from 1.30 P.M. until 9.30 P.M.
- II. Admission is free to all persons over 16 years of age.
- III. Readers are required to write their names and addresses in the Daily Register of the Library. They also write the name of the book desired upon a Library Card, with their signatures, and present

the same to the Director's Clerk, who supplies the book, retaining the card as a receipt. Before leaving the Library, readers return their books to the clerk, and receive their cards.

- IV. The University Professors and Instructors, only, are allowed to take books from the Library Building.
- V. No person is allowed to enter the alcoves, or remove any book from the shelves, without permission of the Director.
- VI. Readers wishing to consult the more valuable illustrated works make special application for that purpose.
- VII. In taking notes, pencils, and not pen and ink, are to be used.
- VIII. Audible conversation and the use of tobacco are strictly forbidden in any part of the Library.
- IX. Any person not conforming to these Regulations will be denied the privilege of the Library.
- X. Any person who defaces, in any way, any book, magazine or paper, or the furniture, or any portion of the building, in addition to being deprived of the privileges of the Library will be prosecuted according to law.

### OBSERVATORY.

By the liberality of Robert H. Sayre, Esq., one of the Trustees of the University, an astronomical observatory was erected on the University grounds, and placed under the charge of the Professor of Mathematics and Astronomy.

In the dome of the observatory is mounted an equatorial telescope, of six inches aperture, by Alvin Clark & Sons. The west wing contains a superior sidereal clock, by Wm. Bond & Sons; a zenith telescope, by Blunt, and a field transit, by Stackpole. There is also a prismatic sextant, by Pistor & Martins.

Students in practical astronomy receive instruction in the use of the instruments and in actual observation.

The grounds upon which the Observatory stands, consisting of seven acres of land adjoining the original grant, were presented to the University by Charles Brodhead, Esq., of Bethlehem.

### THE UNIVERSITY MUSEUM.

In addition to the large collection illustrating all branches of Industrial Chemistry, the Museum includes collections in Metallurgy, Geology, Zoölogy, and Archæology.

The Metallurgical Cabinet already includes specimens illustrating the various processes for obtaining the more common metals.

The Zoölogical Cabinet includes the Werner collection of nearly all the types of American birds with their nests and eggs, and the Packer collection of recent shells.

The Geological Cabinet numbers over ten thousand specimens and includes the Palæontological, Mineralogical, Petrographic, and Economic collections. The first contains good specimens of nearly all the common genera. The Mineralogical division includes the Keim and Røpper collections—the latter being especially complete and valuable from a crystallographic standpoint. The Petrographic division numbers several thousand specimens and, besides including numerous varieties of nearly all the rocks of the globe, contains a duplicate set from the collection of the Second Geological Survey of this State. The Economic division was formed and given by Dr. James P. Kimball, ex-Director of the Mint, and formerly Professor of Economic Geology.

The Cummings Archæological Cabinet numbers three thousand specimens and includes Dr. Stubbs' collection of Indian relics, weapons, and utensils.

### SUMMER SCHOOL OF SURVEYING.

A Summer School of Surveying, extending over a period of four weeks, is held at the University during the long

vacation, provided that the attendance of at least twelve students is assured. In 1896 the school will open on Monday, June 22, at 8:30 A.M. Applications to join it should be made to the Professor of Civil Engineering before June 1, 1896. The tuition fee is \$15, payable in advance.

Three courses in Surveying are offered in the Summer School:

*A. Land and Town Surveying:* corresponding to the course given to civil engineering students in the second term of the Sophomore year. This course is open to any student who has completed the Freshman year, or to any person having a good knowledge of geometry and trigonometry.

*B. Topographical Surveying:* corresponding to the course given to civil engineering students in the first term of the Junior year. This course is open to those who have completed course *A* or its equivalent.

*C. Geodetic Surveying:* corresponding to the course given to civil engineering students in the first term of the Senior year. This is open to those who have completed courses *A* and *B*.

At the close of the Summer School examinations are held and certificates given. Students of the University holding these certificates may omit the corresponding work in Surveying during the academic year and may, with the sanction of the Faculty, use the time thus gained in extra studies.

#### THE CHEMICAL AND NATURAL HISTORY SOCIETY OF THE LEHIGH UNIVERSITY.

This Society was organized in the Fall of 1871, as "The Chemical Society," but was afterwards expanded, as its present title indicates, and admits, by election, students from all departments of the University.

The collections of botanical and zoölogical specimens belonging to the Society are already important. During the past years persons have been sent to Texas and Brazil to collect specimens for these cabinets.

The Society has organized and maintained several courses of public scientific lectures.

### THE ENGINEERING SOCIETY.

This Society was organized in 1873, and admits, by election, students in the Junior and Senior Classes. Its meetings are held fortnightly. At these, papers relating to engineering subjects are read and discussed. From 1885 to 1890 it issued quarterly five volumes of "The Journal of the Engineering Society," containing contributions by the members, alumni, and others. Many of the papers read before this society since 1890 have been published in "The Lehigh Quarterly."

### THE MINING CLUB.

This was organized in 1883 and takes from the Junior, Senior, and Graduate Classes those members of the Mining School who excel in their studies or in practical experience in the subjects of the course.

### THE ELECTRICAL ENGINEERING SOCIETY

was organized in November, 1887, by students in the Advanced Course in Electricity. Its object is to supplement the regular work of the department by the study and discussion of electrical subjects.

### THE AGORA

is a literary and debating society which meets semi-monthly. Once restricted in its membership to students in the School of General Literature, in 1893 it was thrown open to all students. It has proved of great advantage to its members in the development of concise and logical thinking, the promotion of ease before an audience, and the acquirement of experience in parliamentary methods. The society has recently joined the Inter-collegiate Debating Union, and it is expected that this will increase the

interest already existing, and at the same time enlarge the knowledge of current affairs by the discussion of those subjects of the day which are prescribed by the Union.

#### THE CLASSICAL CLUB.

This organization was founded in the Spring of 1889, and consists of the students in the Classical and Latin-Scientific Courses, together with those members of the Faculty who are interested in this department of learning. At its monthly meetings, papers upon philological, historical, and archæological subjects are read by students belonging to the upper classes, and are then discussed and criticised. Thus independent work is encouraged and correct methods of investigation are acquired. This is especially valuable for those men who purpose becoming teachers or original investigators. Reports upon new discoveries and reviews of recent books vary the proceedings and keep the members informed in regard to the advances of philological science.

#### THE NATURAL SCIENCE CLUB OF THE LEHIGH UNIVERSITY.

The object of this organization is systematic study, in connection with field work, in natural history and its associated subjects. Its members are engaged in making a survey, both botanical and mineralogical, of the region within a radius of five miles from the University and propose to collect an herbarium and mineralogical cabinet which shall contain specimens of all the plants and minerals within this district.

#### THE ARCHITECTURAL CLUB.

This club was formed for the purpose of collecting photographic plates of buildings and plans, and to distribute prints of these among its members. Working drawings, models, and specimens of building materials have also been collected. During the past year a series of monthly competitions in pen and ink drawings was held. The active members of the club are students in the architectural and engineering courses.

### THE MATHEMATICAL CLUB.

This club was organized in February, 1895. Its members are students in the Junior and Senior classes. Its object is to continue the study of higher mathematics after having completed the mathematical course of the University.

### THE LEHIGH UNIVERSITY CHRISTIAN ASSOCIATION.

This is a voluntary organization of the students for the promotion of the religious, moral, and social life of the University. It was organized April 18, 1890, and on Oct. 11, 1890, united itself with the Intercollegiate Young Men's Christian Association. The movement is distinctly for and by students, all the officers being chosen from the student body. Those connected with Evangelical churches of whatever creed are eligible to *active membership*; *associate membership* may be claimed by men of good moral standing who are not members of churches. The association is continually growing, and is extending a marked influence for good among the men.

### THE BIBLE CLASS.

A class for the reverent study of the sacred Scriptures, under the direction of the Chaplain, meets every Sunday afternoon at half past three o'clock. This class aims at both practical and theoretical results—the edification of its members in the Word of God, and the application of the “scientific” or “historical” method to the study of Holy Writ.

### FOUNDER'S DAY.

On the second Thursday of October of each year, Commemorative Exercises are held in honor of the Founder of the University. On Thursday, October 11, 1895, the sixteenth Founder's Day was celebrated. An address was delivered by Thomas Messinger Drown, LL.D., President of the University. His subject was “The Educational Value of Engineering Studies.”



## UNIVERSITY SERMON.

This sermon is preached on the Sunday before University Day.

The Rt. Rev. C. Kinloch Nelson, D.D., Bishop of Georgia, was the preacher on Sunday, June 16, 1895, in the Packer Memorial Church.

## THESES.

Theses on the following subjects were prepared by candidates for degrees in 1895 :

## FOR THE DEGREE OF E.M.

"The Drainage Problem of the Nottingham Colliery."

WILLIAM A. ALLGAIER.

"An Efficiency Test of the Ingersoll-Sergeant Air-Compressor at the Nottingham Colliery, Plymouth, Pennsylvania."

JOHN YOUNG BASSELL, JR.

"Investigation of the Working of Blast Furnace No. 6 of the Bethlehem Iron Company."

ROBERT B. BRINSMADE.

## FOR THE DEGREE OF B.A.

"Lucretius's Love of Nature."

HENRY MILTON SNYDER CRESSMAN.

"Cicero's Ideas of the Roman Gods, as represented in his Discourse 'De Natura Deorum.'"

EDWARD CALVIN FERRIDAY.

"The Origin and History of Attic Comedy."

HOWARD SAMUEL HESS.

"The Influence of the Crusades upon the Civilization of Europe."

ELMER AUGUSTUS JACOBY.

"The Logos of Philo Judæus."

WILLIAM ALLEN LAMBERT.

"The Feudal System in England."

ROBERT S. SIEGEL.

ANNUAL REGISTER OF  
FOR THE DEGREE OF B.S.  
(LATIN-SCIENTIFIC COURSE.)

"The Development of the Lyrical and Pastoral Qualities  
in Alfred Tennyson."

DIXON KAUTZ.

(COURSE IN SCIENCE AND LETTERS.)

"Practical Money."

FAYETTE AVERY MCKENZIE.

"The Unification of the German Empire."

JOHN EUGENE STOCKER.

"History of the Trial by Jury."

ROBERT SAYRE TAYLOR.

FOR THE DEGREE OF C. E.

"Design of a Sewerage System for Chillicothe, Ohio."

HERMAN LEON ARBENZ.

"Review of the Sewerage System of Bradford, Pa."

ANTHONY FRANCIS BANNON, JR.

"Design of a Hydraulic Plant for an Electric Light Sta-  
tion for The Lehigh University."

JOHN COLLINSON BARBER.

"Investigation of the Stability of the New Dam at Holy-  
oke, Mass."

ROLLIN CALVERT BASTRESS.

"Review of the Penn Street Bridge, Reading, Pa."

GEORGE BEGGS, JR.

"Location and Construction of a Highway between  
Allentown and Bethlehem."

JOHN HENRY BEST.

"The Turbine as a Water Meter."

WILLIAM BOWIE, B.S.

"The Masonry Dams of the State of Pennsylvania."

WALTER TURPIN BROWN.

"The Narrow-Gauge Railroad at Mt. Gretna, Pa."

JAMES HODGSON BUDD.

“Design of a Sewerage System for Flemington, N. J.”

CHARLES CALVIN BURGESS.

“Design for a Parabolic Bowstring Truss at Freemansburg, Pa.”

FRANCIS LEE CASTLEMAN.

“Plan for a Water Supply for Duncannon, Pa.”

WILLIAM JOSEPH COLLIER.

“Topographical Map of the Country within three miles of The Lehigh University.”

HERBERT MAURICE CRAWFORD.

“Estimate of Cost for Railroad Track and Coal Tipple at Brockwayville, Pa.”

JAMES CHAMBERS DICK.

“The Drainage and Improvement of Broad Street, South Bethlehem, Pa.”

ALFRED WILLIAM ALEXANDER EDEN.

“Design for a Bridge over the Lehigh River at Freemansburg, Pa.”

EDWARD L. FAISON, JR.

“Systems of Water Supply for Irrigation in Mexico.”

ANDRES GARZA GALAN.

“A Proposed Electric Railway from Bethlehem to Nazareth, Pa.”

WALLACE RUSSELL GOSS.

“Design of a Sewerage System for Elkton, Md.”

FREDERICK TAYLOR HAINES.

“Investigation of a Dam for Reservoir D at Carmel, N. Y.”

THOMAS LLOYD HENRY.

“Experiments and Computations on the Deflection of a Bridge Truss.”

IRA MILLER HIGBEE.

“Design of a System of Sewers for Manchester, Va.”

HENRY SCUDDER JAUDON.

“Review of a Highway Bridge at Bloomsburg, Pa.”

ELISHA BARTON JOHN.

"Temperature Stresses in the Deck Pratt Truss at Hockendauqua, Pa."

WARREN BYRON KEIM.

"Determination of Co-ordinates by the Three-Point Problem."

NORMAN PEACH MASSEY.

"Determination of the Exact Stresses and Reactions in a Draw Bridge."

CHARLES FRAZIER MAURICE.

"Design of a Separate System of Sewerage for West Bethlehem, Pa."

STUART TUTTLE MCKENZIE.

"Design of an Overhead Crossing for Northern Central R. R. at Williamsport, Pa."

ROBERT NEILSON, JR.

"Plan for a Water Supply for The Lehigh University."

JAMES HARRY PHILLIPS.

"The Utilization of the Water Power of the Lehigh River."

EUGENE JESSE RIGHTS.

"Comparison of four Pratt Trusses with odd and even Numbers of Panels."

HERBERT TIMOTHY RIGHTS.

"Designs and Estimates for several Retaining Walls 30 feet high."

HARRY KENT SELTZER.

"The Manufacture of Bricks."

JOHN FREDERICK VAN BENTHEM.

"Design of a Separate System of Sewers for South Bethlehem, Pa."

CHARLES HENRY VANSANT.

"Design of Main Sewers for South Bethlehem, Pa."

FRED IRVING WHEELER.

"Errors of Eccentricity and Graduation in three Engineers' Transits."

JOHN MARION WILSON.

## FOR THE DEGREE OF M.E.

"The Theory and Practice of the Manufacture of Gear Wheels."

CLARENCE KEMBLE BALDWIN.

"Evaporation Test of a Boiler Plant."

ROBERT JOSIAH BARTHOLOMEW.

"Tests of Rapidity of Adjustment of a High-speed Engine Governor."

HARRY WILBER BEACH.

"The Exactness of Machine Construction."

CHARLES SUMNER BRICKER.

"Duty-test of Steam Pumps at the Allentown Water Works."

JAMES EMERY BROOKS.

"Design of a Constant-potential Dynamo."

ARTHUR STEBBINS CLIFT.

"Modern Practice in the Use of Single and Multiple Screw Propellers."

MORRIS LLEWELLYN COOKE.

"Effect of Clearance Surface on Cylinder Condensation."

HOWARD STEPHEN DECH.

"Circulation of Water in Steam Boilers, and its Effect on their Efficiency."

BEEKMAN DUBARRY, JR.

"Can Existing Tachometers exactly record Instantaneous Velocities?"

WALTER FERRIS.

"Design of a Sixty-kilo-watt Direct-current Four-pole Generator, Compound-wound."

EDUARDO ANTONIO GIBERGA.

"Determination of the Shaking Forces of an Engine, and its Best Speed."

ROBERT A. MCKEE.

"Tests of a (Harrisburg Ideal) Governor, and Reduction of its Forces and Masses."

JOHN SAMUEL MILLER.

“Design, Construction, and Test of a Webb Floating Dynamometer.”

ARCHIBALD D. MILLER.

“Lubrication.”

JOHN LIVINGSTON POULTNEY.

“Graphical Analysis of Stresses in a Steam Shovel.”

SAMUEL NEELY RITER.

FOR THE DEGREE OF B.S.

(IN METALLURGY.)

“Modern Armor-plating.”

JOHN THOMAS CALLAGHAN, JR.

“The Manufacture of Open-hearth Steel at the Works of the Bethlehem Iron Company.”

WILLIAM WHEELER COLEMAN.

“The Refining of Lead and the Electrolytic Refining of Silver, as conducted by the Pennsylvania Lead Company.”

HOWARD ECKFELDT.

“The Converse Process for the Separation of Franklinite from Willemite and Zincite, as conducted by the Lehigh Zinc and Iron Company.”

GUY HECTOR FARMAN and

ROBERT MELVIN TARLETON.

“Investigation of the Working of Blast Furnace No. 6 of the Bethlehem Iron Company.”

JOSEPH PHILIPS, JR.

“The Magnetic Concentration of Iron Ore.”

WILLARD RANDOLPH VAN LIEW.

(IN MINING.)

“The Contamination of In-take Mine-air by Fire-damp in its Relation to Ventilation.”

FRANKLIN BAKER, JR., and

WILLIAM AGASSIZ JAMES.

“The Utilization of Culm.”

WILLIAM HENRY BROWN.

“The Tail-rope System of Underground Haulage at Maltby Colliery, Lehigh Valley Coal Company.”

ARTHUR HUGHES LEWIS.

"The Monte Aguacate Gold Mines in Costa Rica, Central America."

CARLOS YGLESIAS Y CASTRO.

FOR THE DEGREE OF E.E.

"A Design for a Complete Railway System for South Williamsport, Pa."

CHESTER TERRILL AYRES.

"Triphase Alternating Currents of Electricity."

ERNEST MAR BLEHL.

"Three-phase Electric Power Plant for Washington, D. C."

EUGENE CLARE BROWN.

"The Supply of Power by Electricity for the New York City Underground Rapid Transit Railroad."

ROBERT EDES CHETWOOD, JR., and

JOHN JAMESON GIBSON.

"Incandescent Arc Lamps."

HENRY DE HUFF and

CHAUNCEY MATLOCK.

"Design of an Electric Light and Power Plant, and Study of the Plant at Easton, Pa."

STANLEY CHIPMAN DE WITT.

"Power Consumed by an Electric Car."

GEORGE LANE GABRIO and

THOMAS GRAHAM HAMILTON.

"Efficiency Test of a Westinghouse Transformer."

ROBERT RIEMAN HARVEY and

WILLIAM JACOB HISS, JR.

"Design of a Scott Phase-Converting Transformer."

WILLIAM HOPKINS.

"Wiring of University Buildings."

DREW WILLIAM IRVINE.

"Design of a 15 H.P. Three-phase Induction Motor."

ADOLPH SOMERS KAPPELLA.

"The Telephone System of Bethlehem."

DAVID HENSHEY LACKEY.

"Estimate of Line Construction."

LOUIS EDGAR LANNAN.

"Design for Underground Mail Transmission."

THEODORE PHILIP LOVERING.

"An Investigation of a Thomson-Houston Arc-Lighting  
Dynamo."

WILLIAM SPENCER MURRAY and

JOHN CRUM WHITMOYER.

"General Investigation and Efficiencies of an Electric  
Motor."

HENRY CRIDER QUIGLEY.

"Review of Arc Lamps."

EUGENE SCHWINGHAMMER.

"Transformation of Direct Currents."

EDWIN HARRISON SIGISON.

"Brush Arc-Lighting Apparatus."

JOHN BLAKE SLACK and

WILLIAM WARR.

"Test of a 500-Watt Transformer."

EDWARD GEORGE STEINMETZ and

HARRY AMASA WHITE.

"Design of a Power Station."

JOSEPH BOYER TOWNSEND.

#### FOR THE DEGREE OF A.C.

"Fire-clays and their Manufacture."

ELMER GRANT GODSHALK.

"The Conservation of the Volatile Products in the Cok-  
ing of Bituminous Coal in Bee-hive Ovens."

CHARLES BORROWS JACOBS.

"Cements."

GERALD LEWIS.

"The Discoloration upon Brick and Building Material."

BENJAMIN W. LOEB.



"Purification of Commercial Aluminum."

JOHN EGBERT SHERO.

"Nickel-Plating."

NATHANIEL THURLOW.

"The Formation of Emulsions by Soaps and Alkalies as applied to the Scouring of Fabrics."

EDWARD NEWTON WIGFALL.

"Researches in the Lapachol Group; on the Reduction and Oxidation of Lapachol."

HAROLD LAWDEX WOOD.

#### FOR THE DEGREE OF B.S.

(IN ARCHITECTURE.)

"Specifications, Plans, and Details for a Residence."

HENRY EDWARD KIP.

"Plans for Dormitory Buildings for the Lehigh University."

WILLIAM REINECKE, JR.

"Design for a Railroad Station for South Bethlehem, Pa."

CHARLES FREDERICK TOWNSEND.

#### UNIVERSITY DAY.

This day is the last of the academic year, and falls in 1896 on the third Wednesday in June. On this day orations are delivered by members of the graduating class, and degrees are conferred.

#### EXERCISES ON JUNE 19, 1895.

Reading of Scripture and Prayer by the Rev. Taliaferro F. Caskey, Acting Chaplain of the University.

Salutatory Oration.—"The Inspiration of Life."

WARREN BYRON KEIM.

Oration.—"The College Man in Politics."

FAYETTE AVERY MCKENZIE.

Oration.—"Unsung Heroes."

JOHN EUGENE STOCKER.

Oration.—“Social Evolution.”

WILLIAM ALLEN LAMBERT.

Oration.—“The Marriage of Venice and the Sea.”

ELMER AUGUSTUS JACOBY.

Valedictory Oration.

WALTER FERRIS.

Award of the Wilbur Scholarship to

WALTER EVERETTE BROWN,

of Stamford, Conn., first in rank in the Sophomore Class.

The Wilbur Prizes were awarded as follows :

Freshman Class, Mathematics, to

HARRY STATTEN ZIMMERMAN, of State Line.

WILLIAM ADAM DEHM, of New Britain, Conn.

Freshman Class, French, to

PERCY LAWRENCE REED, of New Bedford, Mass.

Freshman Class, German, to

HAROLD JOHN HORN, of South Bethlehem.

Freshman Class, Themes, to

WILLIAM GRATZ, of Carmel, N. J.

Freshman Class, Rhetoric, to

LEWIS CHESTON STARKEY, of Bustleton.

Freshman Class, Freehand Drawing, to

HOWARD CHARLES PADDOCK, of East Berlin, Conn.

Freshman Class, General Chemistry, to

HENRY THEODORE BORHEK, of Bethlehem.

The following Degrees were conferred by Professor William H. Chandler, Ph.D., Acting President of the University :

E. M.

WILLIAM A. ALLGAIER, B.S.,

JOHN YOUNG BASSELL, JR., B.S.,

ROBERT B. BRINSMADE, B.S.

## B. A.

HENRY MILTON SNYDER CRESSMAN,  
EDWARD CALVIN FERRIDAY,  
HOWARD SAMUEL HESS,  
ELMER AUGUSTUS JACOBY,  
WILLIAM ALLEN LAMBERT,  
ROBERT S. SIEGEL.

## B. S.

DIXON KAUTZ (L.S.),  
FAYETTE AVERY MCKENZIE (SCI.),  
JOHN EUGENE STOCKER (SCI.),  
ROBERT SAYRE TAYLOR (SCI.).

## C. E.

HERMAN LEON ARBENZ,  
ANTHONY FRANCIS BANNON, JR.,  
JOHN COLLINSON BARBER,  
ROLLIN CALVERT BASTRESS,  
GEORGE BEGGS, JR.,  
JOHN HENRY BEST,  
WILLIAM BOWIE, B.S.,  
WALTER TURPIN BROWN,  
JAMES HODGSON BUDD,  
CHARLES CALVIN BURGESS,  
FRANCIS LEE CASTLEMAN,  
WILLIAM JOSEPH COLLIER,  
HERBERT MAURICE CRAWFORD,  
JAMES CHAMBERS DICK,  
ALFRED WILLIAM ALEXANDER EDEN,  
EDWARD L. FAISON, JR.,  
ANDRES GARZA GALAN,  
WALLACE RUSSELL GOSS,  
FREDERICK TAYLOR HAINES,  
THOMAS LLOYD HENRY,  
IRA MILLER HIGBEE,  
HENRY SCUDDER JAUDON,  
ELISHA BARTON JOHN,

WARREN BYRON KEIM,  
STUART TUTTLE MCKENZIE,  
NORMAN PEACH MASSEY,  
CHARLES FRAZIER MAURICE,  
ROBERT NEILSON, JR.,  
JAMES HARRY PHILIPS,  
EUGENE JESSE RIGHTS,  
HERBERT TIMOTHY RIGHTS,  
HARRY KENT SELTZER,  
J. F. VAN BENTHEM VAN DEN BERGH,  
CHARLES HENRY VANSANT,  
FRED IRVING WHEELER,  
JOHN MARION WILSON.

M. E.

CLARENCE KEMBLE BALDWIN,  
ROBERT JOSIAH BARTHOLOMEW,  
HARRY WILBER BEACH,  
CHARLES SUMNER BRICKER,  
JAMES EMERY BROOKS,  
ARTHUR STEBBINS CLIFT,  
MORRIS LLEWELLYN COOKE,  
HOWARD STEPHEN DECH,  
WALTER FERRIS,  
EDUARDO ANTONIO GIBERGA,  
ROBERT A. MCKEE,  
JOHN SAMUEL MILLER,  
ARCHIBALD D. MORRIS,  
JOHN LIVINGSTON POULTNEY,  
SAMUEL NEELY RITER.

B. S.

(IN METALLURGY.)

JOHN THOMAS CALLAGHAN, JR.,  
WILLIAM WHEELER COLEMAN,  
HOWARD ECKFELDT,  
GUY HECTOR FARMAN,  
JOSEPH PHILIPS, JR.,

ROBERT MELVIN TARLETON,  
WILLARD RANDOLPH VAN LIEW.

B. S.

(IN MINING.)

FRANKLIN BAKER, JR.,  
WILLIAM HENRY BROWN,  
WILLIAM AGASSIZ JAMES,  
ARTHUR HUGHES LEWIS,  
CARLOS YGLESIAS.

E.F.

CHESTER TERRILL AYRES,  
ERNEST MAR BLEHL,  
EUGENE CLARE BROWN,  
ROBERT EDES CHETWOOD, JR.,  
HENRY DE HUFF,  
STANLEY CHIPMAN DE WITT,  
GEORGE LANE GABRIO,  
JOHN JAMESON GIBSON,  
THOMAS GRAHAM HAMILTON,  
ROBERT RIEMAN HARVEY,  
WILLIAM JACOB HISS, JR.,  
WILLIAM HOPKINS,  
DREW WILLIAM IRVINE,  
ADOLPH SOMERS KAPPELLA,  
DAVID HENSHEY LACKEY,  
LOUIS EDGAR LANNAN,  
PHILIP THEODORE LOVERING,  
WILLIAM SPENCER MURRAY,  
HENRY CRIDER QUIGLEY,  
EUGENE SCHWINGHAMMER,  
EDWIN HARRISON SIGISON,  
JOHN BLAKE SLACK,  
EDWARD GEORGE STEINMETZ,  
JOSEPH BOYER TOWNSEND,  
WILLIAM WARR,  
HARRY AMASA WHITE,  
JOHN CRUM WHITMOYER.

**A.C.**

ELMER GRANT GODSHALK,  
CHARLES BORROWS JACOBS,  
GERALD LEWIS,  
BENJAMIN W. LOEB,  
JOHN EGBERT SHERO,  
NATHANIEL THURLOW,  
EDWARD NEWTON WIGFALL,  
HAROLD LAWDEN WOOD.

**B. S.**

(IN ARCHITECTURE.)

HENRY EDWARD KIP,  
WILLIAM REINECKE, JR.,  
CHARLES FREDERICK TOWNSEND.

At the close of the exercises of University Day, June 19, 1895, THOMAS MESSINGER DROWN, LL.D., was installed as President of the University, the ceremony being conducted by the Right Reverend Nelson Somerville Rulison, D.D., Bishop of Central Pennsylvania, President of the Board of Trustees.

**THE WILBUR SCHOLARSHIP.**

This Scholarship was founded in 1872 by E. P. Wilbur, Esq., of South Bethlehem, and is the sum of \$200 awarded annually to the student in the Sophomore Class having the best record.

**THE ALUMNI SCHOLARSHIP.**

The Alumni Association of the University has established a Scholarship of the value of \$250 per annum, subject to the following conditions:

1. That the Scholarship shall only be awarded to a student in need of it.
2. That the Scholarship shall not apply to the first year of any students' course; he must without this aid have gone through one year, and must be prepared to start the second year free from all conditions.

3. That the Scholarship shall not be continued to a student who shall at any time during his course carry any condition over eight weeks beyond the date of the examination in which he failed.

Subject only to the above conditions the disposal of the fund shall until otherwise directed be in the hands of the President of the University.

#### THE HENRY S. HAINES MEMORIAL SCHOLARSHIP.

Mrs. Henry S. Haines, of Savannah, Ga., has established a scholarship of the annual value of \$200, which is to be devoted to the support at the Lehigh University, throughout his scholastic career, of one student in the School of Mechanical Engineering; the selection to be made by Mrs. Haines herself during her life-time.

#### WILBUR PRIZES.

By the generosity of E. P. Wilbur, Esq., a fund has been established, yielding an annual income of \$100, for distribution in prizes as the Faculty shall determine.

#### ALUMNI PRIZES FOR ORATORY.

The "Alumni Association of the Lehigh University" has established an annual sum of Fifty Dollars, to be distributed in prizes for excellence in Oratory, subject to the following

##### REGULATIONS.

1. The Contest shall be held on the 22d day of February, or on the day designated by the University to commemorate the birthday of Washington.

2. There shall be a first prize of \$25, a second of \$15, and a third of \$10.

3. To entitle one to be a competitor he must be a member of the Junior Class, taking a regular course.

4. Subjects for the oration shall be announced at the beginning of the first term of every year, and upon one of these each competitor shall write an oration not to exceed 1200 words, taking about eight minutes in delivery.

5. Each oration shall bear upon its first page a fictitious name or motto, and shall be accompanied by a sealed envelope, which shall be superscribed with the same name or motto, and an address by which it may be reclaimed. The envelope shall contain the real name and address of the writer, with the declaration that the oration is his own original work. The examiner, having adopted a standard of excellence, may reject any or all of the orations presented which do not attain to this standard; of such as do—should they be sufficient in number—the best six shall be chosen, and their envelopes opened. The others shall be returned to the address given with their envelopes unopened.

6. The Executive Committee of the Alumni Association, or a committee of not fewer than three to be appointed by them, shall hear the competitors whose orations shall have been approved, and the awards shall be made by a majority of these judges.

7. In awarding the prizes the judges shall consider both the literary merits and the delivery of each oration.

8. These rules are subject to amendment by the Faculty.

At the last contest on February 22, 1895, the competitors were as follows :

Frederic Allyn Daboll, of Plainfield, N. J.

Lewis Benjamin Davenport, of Baltimore, Md.

Henry Neff Herr, of Wheatland Mills.

Robert Edward Laramy, of Bethlehem.

Homer Austin Reid, of Warren, O.

Joseph Wharton Thurston, of South Bethlehem.

The First Prize was awarded to Henry Neff Herr; the Second, to Frederic Allyn Daboll; the Third, to Homer Austin Reid.

The next contest will take place February 22, 1896.



## ENTRANCE EXAMINATION PAPERS.

Used for Examination in 1895.

## I.—ENGLISH.

## I. GRAMMAR.

1. Give the two different methods of comparing the adjective, with examples.
2. Define the *subject* and the *predicate*.
3. How many different ways are there of conjugating the verb? Illustrate by examples.
4. Give the relative pronouns and show how each is used.
5. Analyze the following sentence : It was, indeed, an unexampled circumstance, that a small squadron should be sent to the station which had been long occupied by a large fleet, commanded by the darling of the navy, and the glory of the British empire, to the station where this fleet had for years been wearing away in the most barren, repulsive, and spirit-trying service, in which the navy can be employed ! and that this minor squadron should be sent independently of, and without any communication with the commander of the former fleet, for the express and solitary purpose of stepping between it and the Spanish prizes, and as soon as this short and pleasant service was performed, of bringing home the unshared booty with all possible caution and despatch.

## II. ELEMENTARY RHETORIC.

1. What are the rules for the use of the semi-colon, the colon and the dash ?
2. Explain what synonyms are, with examples ; and show the relation of the words which compose such a group to each other.

3. What figures of speech are found in the following sentences ?

- (a) My love is like a red, red rose.
- (b) Now is the winter of our discontent  
Made glorious summer by this sun of York ;
- (c) O opportunity, thy guilt is great !  
'Tis thou that executest the traitor's treason ;

4. Write a composition of four hundred words upon one of the following subjects : The Career of Nicholas Nickelby ; Thoughts in a Country Church Yard ; The Plot of Kenilworth.

This composition is valued at forty per cent. of this portion of the paper.

## II.—GEOGRAPHY.

Outline maps of the Central part of the United States, and of Northern Asia, were furnished to each applicant, and he was required to draw the boundaries of countries, provinces, states, and territories, and name them, to place and name the capital or chief city of each, and the principal rivers and mountain systems.

## III.—UNITED STATES HISTORY.

1. How and by whom was the State of Delaware founded ?
2. What can you tell about the campaign in the South in 1779 ?
3. Principal events during Jefferson's administration. Had Jefferson one or two terms ?
4. State the causes and the result of the war with Mexico. When was the peace made ?
5. What can you tell about the campaign in Virginia in 1864 ?
6. What is the Bland Silver Bill, voted in 1878 ?

## CONSTITUTION.

1. *a.* How are new States admitted to the Union ?  
*b.* What restrictions upon the formation of new States ?
2. What mention is made in the Constitution of freedom of speech, religion, and the press ?

3. *a.* What disability was incurred by certain persons taking part in the Civil War against the United States?  
*b.* How may this disability be removed?
4. In the United States, who declares war and makes peace?

## IV.—ARITHMETIC.

1. Define ratio, proportion, percentage, cube root, number, composite number, factor, prime factor.

How do you divide a common fraction by a decimal fraction? Give rule for finding greatest common divisor of two or more decimal fractions.

How many inches in a meter? Feet in a mile? Pounds in a kilogram? Cubic inches in a liter?

2. Find the sum of  $\frac{4}{5}$ ,  $\frac{22}{45}$ ,  $\frac{49}{75}$ ,  $\frac{16}{25}$ ,  $\frac{1}{3}$ , and their least common multiple.
3. A 90 day note for \$300, bearing interest at 5%, was dated June 15, 1892. On July 1st, 1892, \$100 was paid on it. July 11, 1892, its owner discounted it at bank at 4% discount. How much did the bank pay him?

$$4. \left[ \left\{ .1230048 \times 3.2990085 \div .000081457 \right\} - \frac{.000004545}{.000017} \right] = ?$$

5. Two wagons are loaded as follows: the first wagon, which weighs one ton forty-five lbs. when empty, contains seven bushels five pecks of corn, and fifty bars of inch square steel, each seven feet three inches long. The second wagon, weighing, empty, 45 lbs. less than a metric ton, contains  $4\frac{1}{4}$  hectoliters of corn and seven steel billets, each  $\frac{5}{8}$  meter long and 27x31 cm. in cross section. Steel weighs 490 lbs. per cubic foot, and corn 70 lbs. 6 oz. per bushel. Which wagon, loaded, weighs the most, and how much in pounds? in kilograms?

## V.—GEOMETRY.

1. If a figure is symmetrical with respect to two axes at right angles to each other, it is also symmetrical with respect to the intersection of these axes as a centre of symmetry.

2. Two incommensurable ratios are equal if their approximate numerical values are always equal when both are expressed within the same measure of precision however small.
3. A parallel to the base of a triangle divides the other two sides proportionally.
4. The bisector of the exterior angle of a triangle divides the opposite side externally into segments which are proportional to the adjacent sides, and conversely.
5. Compute  $\pi$  by the method of perimeters.
6. Find the locus of all points whose distances from two fixed points are in a given ratio.
7. The area of the regular inscribed dodecagon is equal to three times the square of the radius.
8. Of all isoperimetric plane figures the circle is the maximum, and conversely.
9. The plane which bisects a diedral angle is the locus of all points equally distant from the faces of the angle.
10. Define: (a) Geometrical solid, angle, hypothesis, postulate, limit, mean proportion.  
 (b) What is meant by: "An angle at the centre is measured by its intercepted arc"? When is a line said to be divided in extreme and mean ratio? When harmonically? When are two figures equal? When equivalent?  
 (c) Define: Numerical measure of magnitude, plane, polyedral angle, symmetrical polyedral angles. What is a "centre of similitude"?

## VI.—ALGEBRA.

1. Define equation, radical, root of an equation, simultaneous equations, imaginary quantity. What is the meaning of a negative exponent? A fractional exponent?  
 How do you free a fraction of negative and fractional exponent, when its terms are monomial? Binomial?

2. When can radicals be simplified, and how? How do you clear an equation of radicals? Of negative exponents? What is meant by verifying an equation? When is an equation said to be satisfied?
4. Find the greatest common divisor of the following:  
 $x^4 + 13x^3 + 33x^2 + 31x + 10$ ,  $4x^3 + 39x^2 + 66x + 31$ .  
 Find the least common multiple of the following:  
 $x^4 - 256$ ,  $x^2 - 5x + 4$ ,  $x^2 + 3x - 4$ .
4. Expand to five terms by the binomial formula,—  

$$\sqrt[4]{\sqrt{x-2}\sqrt{y}}, \quad \frac{1}{\sqrt[4]{1-x^2}}$$
5. Solve and verify,—  

$$\frac{32}{x^2-4} + 3 - \frac{5x+4}{2-x} = \frac{22}{x-2}; \text{ also } \frac{\sqrt{x^2+2} - \sqrt{6x}}{x+4} = \frac{2-x}{\sqrt{x^2+2} + \sqrt{6x}}$$
6. Solve  

$$\begin{aligned} x+y+z+w &= 3 \\ x-y+z+2w &= 12 \\ x+y-z-w &= -7 \\ x+2y+z+3w &= 6 \end{aligned}$$
7. Produce formula showing relation of parts in a geometrical progression.
8. Solve  $x^3 - 6x^2 + 13x - 10 = 0$ ; also,  $x^3 + 5x^2 + 3x - 9 = 0$ .
9. Solve  $xy = 2x + y - 2$  also,  $xy = 3x + y - 6$   
 $y^2 = x^2 - 5$   $x^2 + xy = 24$
10. Divide  $a$  into two such parts that the difference of their squares shall be  $b$ .  
 What number is that which, being divided by the product of its two digits, the quotient is 3; and if 18 be added to it, the digits will be reversed?

## VII.—PHYSICS.

1. Define:

- a.* Absolute unit of force.
- b.* Simple pendulum.
- c.* Inertia.
- d.* Capacity of a condenser.
- e.* Induced currents.

- f.* Electrolysis.
  - g.* Pitch of a sound.
  - h.* Sympathetic vibrations.
  - i.* Overtones.
  - j.* Absolute zero.
  - k.* Radiant heat.
  - l.* Thermal unit.
  - m.* Diffused light.
  - n.* Critical angle.
  - o.* Dispersion of light.
2. Describe the Atwood's machine and explain its use.
  3. Describe the Plate Electric machine and explain its action.
  4. Describe the telephone.
  5. Explain the principle of a freezing mixture composed of ice and salt.
  6. How long will it take a ball to roll down an inclined plane 1000 meters long and 50 meters high and what will be its final velocity?
  7. What will 10 cu. cm. of lead (sp. gr. 11.35) weigh in turpentine, whose sp. gr. is .87?
  8. How long must a current of .144 amperes flow through a resistance of 46.64 ohms to generate heat enough to warm 10 grams of water from  $0^{\circ}$  C. to  $13.9^{\circ}$  C.?  
How many foot-pounds of work will be done by the current in the same time?
  9. If a pure copper wire has a weight of one grain and a resistance of .2106 ohms per foot and a commercial copper wire has a resistance of .547 ohms per 20 feet and its conductivity is 93.9 per cent. that of pure copper, what is its weight?
  10. What will be the result if we mix one pound of steam at  $120^{\circ}$  C. and 7 pounds of ice at  $-10^{\circ}$  C. ? (sp. ht. of ice .505, sp. ht. of steam .4805).
  11. What will be the volume of 1000 cu. cm. of gas at  $100^{\circ}$  C. under a pressure of 30 inches of mercury if the temperature be changed to  $200^{\circ}$  C. and the pressure to 35 inches of mercury?

12. How long does it take sound to travel one mile, if the temperature of the air is  $50^{\circ}$  C. ?

### VIII.—PHYSICAL GEOGRAPHY.

1. Name the motions of the earth, state proofs, and what they cause.
2. Give classification of lakes, with an example of each.
3. Give classification of winds, with a description of each class.
4. Describe the Gulf Stream.
5. What causes (a) hoar frost, (b) dew, (c) hail.
6. Describe the rainbow.
7. Name and locate chief minerals of the United States.
8. Give the characteristics and distribution of the Caucasian race.
9. Describe the electrical phenomena of the atmosphere.
10. What are deltas and where found in the United States ?

### IX.—LATIN.

#### I. GRAMMAR.

1. Give the derivation and the literal meaning according to the derivation, of—*praestiterunt*, *insisterent*, *coacervatis*, *remitterent*, *nequicquam*, *ascendere*, *iniquissimum*.
2. Write out the imperative mood and perfect subjunctive of—*accidissent*, *jacentibus*, *subire*.
3. Decline—*rem*, *rubis*, *sepes*, *agminis*, *iter*, *sibi*, *quidquid*, and give their genders.
4. Give principal parts of—*adjuvabant*, *deferebat*, *incisis*, *perspici*, *enatis*, *deligant*, *secuti*, *intercedere*, *adoriri*, *pulsa*.
5. Write out future and future perfect of—*possunt*, *deferebant*, *effecerant*, *impedirent*.
6. Give the derivation and the literal meaning according to the derivation, of—*munimentum*, *impediretur*, *admissis*.
7. Decline, and give the genders of—*rebus*, *locum*, *complures*, *exercitus*, *nocti*, *sarcinis*.
8. Write out imperative mood of—*capio*, *fero*. Also the imperfect subjunctive of—*possum*, *volo*, *fio*.
9. Decline throughout—*quisquam*, *quisquis*, *alius*.

## II. CÆSAR.

*Translate :*

Cæsar, paucos dies in eorum finibus moratus, omnibus vicis aedificiisque incensis, frumentisque succisis, se in fines Ubiorum recipit; atque iis auxilium suum pollicitus, si ab Suevis premerentur, haec ab iis cognovit: 'Suevos posteaquam per exploratores pontem fieri comperissent, more suo concilio habito, nuntios in omnes partes dimisisse, uti de oppidis demigrarent, liberos, uxores, suaque omnia in silvis deponerent, atque omnes, liberos, qui arma ferre possent, unum in locum convenirent; hunc esse delectum medium fere regionum earum, quas Suevi obtinerent; hic Romanorum adventum exspectare, atque ibi decertare constituisse.'

Cæsar, *B. G. IV.*, 10.

## III. VERGIL.

*Translate :*

1. Ecce, manus juvenem interea post terga revinctum  
pastores magno ad regem clamore trahebant  
Dardanidae, qui se ignotum venientibus ultro,  
hoc ipsum ut strueret Trojamque aperiret Achivis,  
obtulerat, fidens animi atque in utrumque paratus.  
seu versare dolos, seu certae occumbere morti.

*Aen. I. l. 57.*

Write out lines 4 and 5, marking the feet and caesuras. In what part of the story does this passage occur? Decline *Dardanidae* and explain the formation of the word.

2. Postera cum primo stellas Oriente fugarat  
clara dies, socios in coetum litore ab omni  
advocat Aeneas, tumulique ex aggere fatur:  
Dardanidae magni, genus alto a sanguine divom,  
annuus exactis completur mensibus orbis,  
ex quo reliquias divinique ossa parentis  
condidimus terra maestasque sacravimus aras.

*Aen. V. l. 42.*

How does *fugo* differ from *fugio*? Give synopsis of *fatur* in 3d Pers. Sing. Explain form *divom*.



*Translate:*

Vix ea fatus eram ; tremere omnia visa repente,  
 Liminaque lauresque dei, totusque moveri  
 Mons circum, et mugire adytis cortina reclusis.  
 Submissi petinus terram, et vox fertur ad aures :  
 "Dardanidæ duri, quae vos a stirpe parentum  
 "Prima tulit tellus, eadem vos ubere laeto  
 "Accipiet reduces. Antiquam exquirite matrem.  
 "Hic domus Aeneæ cunctis dominabitur oris,  
 "Et nati natorum, et qui nascentur ab illis."

*Aen. III., 90-98.*

#### IV.—CICERO.

*Translate :*

Nunc ego, patres conscripti, mea video quid intersit. Si eritis secuti sententiam C. Cæsaris, quoniam hanc is in re publica viam, quae popularis habetur, secutus est, fortasse minus erunt, hoc auctore et cognitore hujusce sententiae, mihi populares impetus pertimescendi: sin illam alteram, nescio an amplius mihi negotii contrahatur. Sed tamen meorum periculorum rationes utilitas rei publicae vincat. Habemus enim a Cæsare, sicut ipsius dignitas et majorum ejus amplitudo postulabat, sententiam tamquam obsidem perpetuae in rem publicam voluntatis. Intellectum est, quid interesset inter levitatem contionatorum et animum vere popularem, salutem populi consulentem.—*Cat. IV., 5.*

#### V.—SIGHT READING.

*Translate (Cæsar, B. G., VI., 35):*

Haec in omnibus Eburonum partibus gerebantur, diesque appetebat septimus, quem ad diem Cæsar ad impedimenta legionemque reverti constituerat. Hic quantum in bello fortuna possit, et quantos adferat casus, cognosci potuit. Dissipatis ac perterritis hostibus, ut demonstravimus, manus erat nulla quae parvam modo causam timoris afferret. Trans Rhenum ad Germanos pervenit fama, diripi Eburones atque ultro omnes ad praedam evocari. Cogunt equitum duo milia Sugambri, qui sunt proximi

Rheno, a quibus receptos ex fuga Tencteros atque Usipetes supra docuimus.

*Translate* (Cicero's *Epist.*):

Miseriae nostrae potius velim quam inconstantiae tribuas, quod a Vibone, quo te arcessebamus, subito discessimus: allata est enim nobis rogatio de perniciē mea, in qua, quod correctum esse audieramus, erat ejus modi, ut mihi ultra quadringenta milia liceret esse. Illo cum pervenire non liceret, statim iter Brundisium versus contuli ante diem rogationis, ne et Sicca, apud quem eram, periret et quod Melitae esse non licebat. Nunc tu propera, ut nos consequare, si modo recipiemur. Adhuc invitamur benigne, sed quod superest timemus. Me, mi Pomponi, valde paenitet vivere; qua in re apud me tu plurimum valuisti. Sed haec coram. Fac modo ut venias.

#### VI.—COMPOSITION.

*Write in Latin:*

Epaminondas, the Theban, when his soldiers were saddened (abl. abs.) because the wind had carried away (perf. pass. part.) from his spear an ornament hanging after the manner (*mōre*) of a fillet, [and] driven [it] upon the tomb of a certain Lacedæmonian, said: "Do not be alarmed, soldiers; destruction is portended to the Lacedæmonians; for (their) tombs are adorned with offerings."

#### VII.—HISTORY.

1. Describe the acts and characters of the first three Kings.
2. Tell the story of Coriolanus.
3. Describe the conquest of the Gauls in northern Italy.
4. Describe the invasion of Italy by Hannibal.
5. Describe the city and empire of Rome under Augustus.

## X.—GREEK.

## I. GRAMMAR.

1. *a.* Write correctly τέτριβσθαι, τρέφσω, συγγενής, θέθηθι.  
*b.* Contract τιμάσαι, δηλόης, τείχεα, ἀργυρέαν.  
*c.* Accent ἄνθρωποι τινες εἰσιν σοφοί.
2. Decline in the singular χάρις, ἡπαρ, εἰς, μνᾶ, σοφός; in the plural παῖς, πᾶς, εὐγενής, τιμή, ἀπλοῦς.
3. Give the genitive, singular and plural, of ναῦς, γραῦς, νοῦς, βοῦς; the dative, singular and plural, of εἰδώς, κύων, γυνή, ἀνὴρ; the accusative, singular and plural, of βασιλεύς, πόλις, ἐλπίς, μήτηρ.
4. Compare πολὺς, μέγας, σῶφρων, ἐχθρός.
5. Translate, *six hundred, second, five times, where? how?*
6. Give the principal parts of γίγνομαι, ἐρχομαι, δύναμαι, φαίνω.
7. Inflect the indicative (perfect and pluperfect) of οἶδα; the optative of εἰμί; the present subjunctive active of τιμάω; the second aorist imperative of ἵστημι.
8. Give the synopsis of the aorist (three voices) of τίθημι; of the future of μένω; of the perfect middle of λείπω.
9. Give the first person singular of the future indicative active of τίκτω, φέρω; of the aorist indicative active of πίπτω, τρέχω; of the perfect indicative active of πάσχω, φημί; of the perfect indicative middle of πείθω, ἀφικνέομαι.
10. ἐλοι, ἀλοίη, αἰρεθείη, αἰροίη, αἰρήσοι: where is each of these forms made? Give the first person singular (*a*) of the same mood and tense; (*b*) of the same tense, indicative mood; (*c*) of the present indicative.

## II. XENOPHON.

1. *Translate:*

\*Ἄνδρες, ἐάν μοι πεισθῆτε, οὔτε κινδυνεύσαντες οὔτε πονήσαντες τῶν ἄλλων πλεον προτιμήσεσθε στρατιωτῶν ὑπὸ Κύρου. τί οὖν κελεύω ποιῆσαι; νῦν δεῖται Κύρος ἐπεσθαι τοὺς Ἑλλήνας ἐπὶ βασιλέα· ἐγὼ οὖν φημι ὑμᾶς χρῆναι διαβῆναι τὸν Εὐφράτην ποταμόν, πρὶν δῆλον εἶναι ὅ, τι οἱ ἄλλοι Ἑλληνες ἀποκρινούνται Κύρῳ. ἐὰν μὲν γὰρ ψηφίσωνται ἐπεσθαι, ὑμεῖς δόξετε αἰτιοὶ εἶναι ἄρξαντες τοῦ διαβαίνειν καὶ ὥς προθυμοτάτοις

οὖσιν ἡμῖν χάριν εἰσεται Κῦρος καὶ ἀποδώσει · ἐπίσταται δ' εἰ τις καὶ ἄλλος · ἐὰν δ' ἀποψηφίσωνται οἱ ἄλλοι, ἄπιμεν μὲν ἅπαντες τοῦμπαλιν, ἡμῖν δὲ ὡς μόνους πειθόμενοις πιστοτάτοις χρήσεται καὶ εἰς φρούρια καὶ εἰς λοχαγίας, καὶ ἄλλον οὐτινος ἂν δέησθε οἶδα ὅτι ὡς φίλοι τεύξεσθε Κύρου. ἀκούσαντες ταῦτα ἐπέθοντο καὶ διεβησαν, πρὶν τοὺς ἄλλους ἀποκρίνασθαι. Κῦρος δ' ἐπεὶ ἤσθητο διαβεβηκότας, ἤσθη τε καὶ τῷ στρατεύματι πέμψας Γλοῦν εἶπεν · Ἐγὼ μὲν, ὦ ἄνδρες, ἤδη ὑμᾶς ἐπαινῶ · ὅπως δὲ καὶ ὑμεῖς ἐμὲ ἐπαινέσετε, ἐμοὶ μὲλίσσει, ἢ μηκέτι με Κύρον νομίζετε.

Explain the conditional sentence (line 5) ἐὰν ψηφίσωνται, δόξετε, and translate into Greek the following: "if they should vote, you would seem," "if they voted, you seemed," "if they had voted, you would have seemed."

Explain the construction of στρατιωτῶν (l. 2), οὐτινος (l. 10), Κύρον (l. 10), εἶναι (l. 4), διαβαίνειν (l. 6), πιστοτάτοις (l. 9).

## 2. Translate:

Ἐνταῦθα Τισσαφέρνης καὶ οἱ σὺν αὐτῷ κάειν ἐπεχείρησαν τὰς κώμας. καὶ τῶν Ἑλλήνων μάλα ἠθύμυσάν τινες, ἐννοούμενοι μὴ τὰ ἐπιτήδεια, εἰ κάοιεν, οὐκ ἔχοιεν ὁπόθεν λαμβάνοιεν. καὶ οἱ μὲν ἀμφὶ Χειρίσοφον ἀπῆσαν ἐκ τῆς βοηθείας · ὁ δὲ Ξενοφῶν ἐπεὶ κατέβη, παρελαίνων τὰς τάξεις, ἡνίκα ἀπὸ τῆς βοηθείας ἀπῆντησαν οἱ Ἑλληνες, ἔλεγεν · Ὁράτε, ὦ ἄνδρες Ἑλληνες, ὑφίεντας τὴν χώραν ἡδη ἡμετέραν εἶναι: ἃ γάρ, ὅτε ἐσπένδοντο, διεπράττοντο, μὴ κάειν τὴν βασιλείῃς χώραν, νῦν αὐτοὶ κάουσιν ὡς ἄλλοτριαν. ἀλλ' ἐάν ποιν καταλίπωσί γε αὐτοῖς τὰ ἐπιτήδεια, ὄψονται καὶ ἡμᾶς ἐνταῦθα πορευομένους. ἀλλ', ὦ Χειρίσοφε, ἔφη, δοκεῖ μοι βοηθεῖν ἐπὶ τοὺς κάοντας ὡς ὑπὲρ τῆς ἡμετέρας. ὁ δὲ Χειρίσοφος εἶπεν · Οὐκ οὐν ἐμοιγε δοκεῖ · ἀλλὰ καὶ ἡμεῖς, ἔφη, κάωμεν, καὶ οὕτω θᾶπτον παύσονται.

Explain the construction of κάοιεν (l. 3), ἔχοιεν (l. 3), λαμβάνοιεν (l. 3), ὑφίεντας (l. 6), κάωμεν (l. 11).

What is the subject of δοκεῖ (l. 9)?

What is the derivation of τάξεις, ἀθυμέω?

Give the interrogative, demonstrative, and indefinite adverbs corresponding to ὁπόθεν.

ἀπῆσαν (l. 3), κατέβη (l. 4): explain the difference of tense.

Give, from the two passages above, examples of as many of the classes of verbs as possible, with the present stem in each case.

3. *Translate, at sight :*

Καὶ ναὶ μὰ Δῖ', ἔφη ὁ Σωκράτης, Κῦρός γε, εἰ ἐβίωσεν, ἄριστος ἂν δοκεῖ ἀρχῶν γενέσθαι, καὶ τούτου τεκμήρια ἄλλα τε πολλὰ παρέσχηται καὶ ὑπό τε περὶ τῆς βασιλείας τῷ ἀδελφῷ ἐπορεύετο μαχοίμενος, παρὰ μὲν Κῦρον οὐδεὶς λέγεται αὐτομολῆσαι πρὸς βασιλέα, παρὰ δὲ βασιλέως πολλὰι μυριάδες πρὸς Κῦρον. ἐγὼ δὲ καὶ τοῦτο ἡγοῦμαι μέγα τεκμήριον ἀρχοντος ἀρετῆς εἶναι, ὃ ἂν ἐκόντες πειθῶνται καὶ ἐν τοῖς δεινοῖς παραμένειν ἐθέλωσιν. ἐκείνῳ δὲ καὶ οἱ φίλοι ζῶντί τε συνεμάχοντο καὶ ἀποθανόντι συναπέθανον πάντες περὶ τὸν νεκρὸν μαχόμενοι πλὴν Ἀριαίου. Ἀριαῖος δ' ἔτυχεν ἐπὶ τῷ εὐωνύμῳ κέρατι τεταγμένος.

βίωω, live. τεκμήριον, proof. αὐτομολέω, desert.

## III. HOMER.

1. *Translate :*

οἱ δ' ὅτε δὴ λιμένος πολυβενθέος ἐντὸς ἴκοντο,  
 ἰστία μὲν στείλαντο, θέσαν δ' ἐν νηὶ μελαίνῃ,  
 ἰστὸν δ' ἰστοδόκη πέλασαν προτόνοισιν ὑφέντες  
 καρπαλίμως, τὴν δ' εἰς ὄρμον προέρεσαν ερετμοῖς.  
 ἐκ δ' εὐνὰς ἐβαλον, κατὰ δὲ πρυμνήσι' ἐδῆσαν.  
 ἐκ δὲ καὶ αὐτοὶ βαῖνον ἐπὶ ῥηγμῖνι θαλάσσης,  
 ἐκ δ' ἐκατόμβην βῆσαν ἐκπρόλῳ Ἀπόλλωνι.  
 ἐκ δὲ Χρυσῆς νηὸς βῆ ποιοπόροιο.  
 τὴν μὲν ἔπειτ' ἐπὶ βωμὸν ἄγων πολέμητις Ὀδυσσεὺς  
 πατρὶ φίλῳ ἐν χερσὶ τίθει, καὶ μιν προσέειπεν.  
 ὦ Χρῖση, πρό μ' ἔπεμψεν ἄναξ ἀνδρῶν Ἀγαμέμνων  
 παῖδά τε σοὶ ἀγέμεν, Φοῖβω θ' ἱερὴν ἐκατόμβην  
 ῥέξαι ὑπὲρ Δαναῶν, ὅφρ' ἱλασόμεσθα ἄνακτα,  
 ὅς νῦν Ἀργεῖοισι πολέστονα κήδε' ἐφῆκεν.

Give the prose equivalents of στείλαντο (l. 2), θέσαν (l. 2), νηὸς (l. 8), μιν (l. 10), προσέειπεν (l. 10), ἀγέμεν (l. 12), ἱλασόμεσθα (l. 13).

Mark quantities, feet, and caesuras in lines 5-8.

2. *Translate :*

Τῶν δ', ὥστ' ὀρνίθων πετεηνῶν ἔθνεα πολλὰ.  
 χηνῶν ἢ γεράνων ἢ κύκνων δονλιχοδείρων,  
 Ἀσίῳ ἐν λειμῶνι, Καῦστρίου ἀμφὶ ῥέεθρα,  
 ἐνθα καὶ ἐνθα ποτῶνται ἀγαλλόμενα πτερύγεσσιν,

κλαγγηδὸν προκαθίζοντων, σμαραγεῖ δέ τε λειμών,  
 ὥς τῶν ἔθνεα πολλά νεῶν ἄπο καὶ κλισιάων  
 ἐς πεδῖον προχέοντο Σκαμάνδριον · αὐτὰρ ὑπὸ χθῶν  
 σμερδαλέον κονάβιζε ποδῶν αὐτῶν τε καὶ ἵππων.  
 ἔσταν δ' ἐν λειμῶνι Σκαμανδρίφ' ἀνθεμένετι  
 μνῖοι, ὅσσα τε φύλλα καὶ ἄνθεα γίγνεται ὥρη.

Give the prose equivalents of ἔθνεα (l. 1), πτερύγεσσιν (l. 4), ἔσταν (l. 9), ὅσσα (l. 10).

Explain the construction of προκαθίζοντων (l. 5), ποδῶν (l. 8).

#### IV. HISTORY.

1. Give a brief account of the Spartan constitution.
2. Give an outline of the two Persian wars, with dates.
3. Describe the reforms of Kleisthenes; of Perikles.
4. When and by whom was the Theban supremacy established and when did it come to an end?
5. When did the Athenian expedition to Sicily take place? Who were its leaders? What became of them and what were the results of the expedition?

## STUDENTS.

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Clas.—Classical.	C.E.—Civil Engineering.
L.S.—Latin-Scientific.	E.M.—Mining Engineering.
Sci.—Science and Letters.	M.E.—Mechanical Engineering.
A.C.—Analytical Chemistry.	E.E.—Electrical Engineering.
Arch.—Architecture.	

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Herbert Huebener Beck,	A.C.,	Lititz.
Edgar Tweedy Belden,	C.E.,	Springdale, Conn.
Moriz Bernstein,	C.E.,	Philadelphia.
Warren Joshua Bieber,	Clas.,	Bethlehem.
Daniel William Bliem,	C.E.,	Pottstown.
Benjamin Franklin Bossert,	C.E.,	Phoenixville.
Howard Franklin Boyer,	Sci.,	Springtown.
Edward Elisha Bratton,	C.E.,	Lewistown.
Frank Shepard Bromer,	M.E.,	Schwenksville.
Maximilian Joseph Bucher,	A.C.,	Columbia.
George Amandus Buvinger,	M.E.,	Dayton, O.
Aaron Beaumont Carpenter,	E.E.,	Avondale.



	COURSE.	RESIDENCE.
Malcolm Carrington,	E. E.,	Richmond, Va.
Frank Leslie Cooke,	E. E.,	Hackettstown, N. J.
Eckley Samuel Cunningham,	M. E.,	Drifton.
Samuel Philip Curtis,	M. E.,	Penn Yan, N. Y.
Frederic Allyn Daboll,	C. E.,	Plainfield, N. J.
John William Dalman,	M. E.,	Fort Wayne, Ind.
†Lewis Benjamin Davenport,	C. E.,	Baltimore, Md.
Robert Adriance Davidson,	E. E.,	Northport, L. I.
Samuel Moses Dessauer,	Arch.,	Montrose.
William Carter Dickerman,	M. E.,	Milton.
Benjamin Irvin Drake,	E. M.,	South Bethlehem.
Frank Oliver Dufour,	C. E.,	Hardesty, Md.
Edward Miall Durham, jr.,	C. E.,	Vicksburg, Miss.
Edward Hiram Dutcher, jr.,	M. E.,	South Meriden, Conn.
Timothy Sharpe Eden,	E. E.,	Brown's Town, Ja-
Earle Bradford Edgerton,	Clas.,	Rutland, Vt. [maica.
George Ramsey Enscoe,	C. E.,	Bennett P. O.
William Alvin Evans,	E. M.,	Summit Hill.
Charles Victor Ferriday,	M. E.,	South Bethlehem.
Curtis Bertram Flory,	E. E.,	Scranton.
Clarence Richard Fountain,	E. E.,	Washington, D. C.
Thomas Joseph Gannon,	M. E.,	South Bethlehem.
James Brown Given,	E. E.,	Carlisle.
John Savage Graff,	E. E.,	Williamsport.
William Heald Groverman,	M. E.,	Ellicott City, Md.
David Hall,	E. E.,	Fayetteville, Tenn.
Henry Neff Herr,	C. E.,	Wheatland Mills.
Howard Drysdale Hess,	M. E.,	Philadelphia.
Robert Parsons Howell,	C. E.,	Blairstown, N. J.
William Thomas Hutchins,	C. E.,	Wyoming.
William Steell Jackson,	E. E.,	Duncannon.
Victor Albert Johnson,	E. M.,	St. Paul, Minn.
James Keys,	C. E.,	Conshohocken.
Victor Witmer Kline,	C. E.,	Lockport, N. Y.
Robert Edwin Kresge,	A. C.,	South Bethlehem.
Robert Edward Laramy,	Clas.,	Bethlehem.
Telford Lewis,	E. M.,	Blairsville.
Bruce Emerson Loomis,	E. E.,	Wilkes-Barre.

†Died January 6.

	COURSE.	RESIDENCE.
Caleb Wheeler Lord,	M.E.,	Lebanon.
John Buckley MacBride,	C.E.,	Deckertown, N.J.
Clifford Sherron MacCalla,	E.E.,	Philadelphia.
Burt Melville McDonald,	C.E.,	Springfield, Mass.
James Gordon Mason,	E.M.,	West Pittston.
Victor Emanuel Masson,	A.C.,	Hammondsport, N. Y.
Edward Williamson Miller,	E.M.,	Bethlehem.
Rafael de la Mora,	M.E.,	Guadalajara, Mex.
Charles Howard Morgan,	E.E.,	Maxatawny.
William Hitz Mussey,	E.E.,	Washington, D.C.
John Henry Myers,	C.E.,	Lewistown.
Franklin Oberly,	E.E.,	Easton.
Louis Atwell Olney,	A.C.,	Providence, R. I.
Horace Lucius Palmer,	C.E.,	Frenchtown, N.J.
Jacob Grafius Petrikin,	Arch.,	Lock Haven.
Morris Wright Pool,	M.E.,	Washington, D. C.
James Lee Rankin, jr.,	M.E.,	Savannah, Ga.
Henry Paul Reed,	E.E.,	Fort Schuyler, N. Y.
Homer Austin Reid,	C.E.,	Warren, O.
Antonio M. Ros-y-Jané,	M.E.,	Guantanamo, Cuba.
George Homer Ruggles,	C.E.,	Cherokee, Iowa.
Clement Clarence Rutter,	C.E.,	Lansford.
John Cornelius Sesser,	C.E.,	Saint Joseph, Mich.
Arthur Yeager Shepherd,	M.E.,	Wilkes-Barre.
Luther D. Showalter,	C.E.,	Pottstown.
Henry Shriver, jr.,	M.E.,	Cumberland, Md.
Harvey Wilson Sprague,	M.E.,	South Bethlehem.
Ambrose B. Strickler,	M.E.,	Waynesboro.
Edward Ernest Taylor,	M.E.,	Fort Wayne, Ind.
William Bailey Taylor,	E.E.,	Bethlehem.
John Augustus Thomson,	E.M.,	Summit Point, W.Va.
Edward Coppée Thurston,	E.M.,	South Bethlehem.
Joseph Wharton Thurston,	Clas.,	South Bethlehem.
Curtis Edwards Trafton,	E.E.,	Fall River, Mass.
Harry Conklin Tripp,	M.E.,	Millerton, N. Y.
John Scofield Wallace,	E.M.,	New Castle.
Ulysses Grant S. Walters,	C.E.,	Pottstown.
Harry Dallam Webster,	M.E.,	Baltimore, Md.

	COURSE.	RESIDENCE.
John Eugene Weideman,	E. E.,	Washington, D. C.
Frank Thomas Weiler,	C. E.,	Pequea.
William Gwilym Whildin,	E. M.,	Lansford.
Davis Sanno Williams,	Arch.,	Fort Snelling, Minn.
David William Wilson, jr.,	Arch.,	Brooklyn, N. Y.
Job Roberts Wilson,	E. E.,	Bethlehem.
Alfred Mahlon Worstall,	E. E.,	Millville, N. J.

## JUNIOR CLASS.

	COURSE.	RESIDENCE.
Francis DuPont Ammen,	M. E.,	Ammendale, Md.
Henry Jonathan Biddle Baird,	E. M.,	West Chester.
Lathrop Hutchings Baldwin,	M. E.,	Allentown.
Charles Marshall Barton,	C. E.,	Pikesville, Md.
Frank Breckenridge Bell,	M. E.,	Mercer.
Harry Layfield Bell,	E. E.,	Norfolk, Va.
William Ragan Binkley,	E. E.,	Hagerstown, Md.
Francis Jos. Blickensderfer,	E. E.,	Bethlehem.
Bertine Frederic Borhek,	A. C.,	West Bethlehem.
Charles Schwartze Bowers,	E. E.,	Philadelphia.
John Boyt,	E. M.,	Adamsford.
William Burke Brady,	M. E.,	Harrisburg.
Daniel John Broughal,	A. C.,	South Bethlehem.
Walter Everette Brown,	E. E.,	Stamford, Conn.
Robert Berdell Cable, jr.,	M. E.,	Bethlehem.
Sinclair Wiggins Chiles	C. E.,	Sims City, Fla.
Thomas Holland Clagett,	E. M.,	Berryville, Va.
Thomas Micks Clinton,	E. E.,	Baltimore, Md.
Barton Olmsted Curtis,	C. E.,	Iowa City, Iowa.
Patrick Edward Dinan,	A. C.,	South Bethlehem.
Louis Diven,	E. E.,	Elmira, N. Y.
Clifford George Dunnells,	C. E.,	Pittsburg.
Stuart Rhett Elliott,	E. M.,	Beaufort, S. C.
Albert Andrew Finkh,	M. E.,	Yonkers, N. Y.
Ira D. Fulmer,	E. E.,	Richland Centre.

	COURSE.	RESIDENCE.
Francisco Martinez Gallardo,	M.E.,	Guadalajara, Mex.
Orrin Satterlee Good,	E.E.,	Lock Haven.
Ralph Scofield Griswold,	E.E.,	Madison, N. J.
John Lewis Gross,	M.E.,	Wilkes-Barre.
Hugh Ellmaker Hale,	C.E.,	Philipsburg.
William Thomas Hanly,	C.E.,	Philadelphia.
Erle Reiter Hannum,	E.E.,	Pottsville.
William Stephen Hiester,	E.E.,	Elmira, N. Y.
Ross Nathaniel Hood,	E.E.,	Duncannon.
Oliver Zell Howard,	M.E.,	Hagerstown, Md.
Henry Taylor Irwin,	M.E.,	Allegheny.
James Madison Jackson,	M.E.,	Parkersburg, W. Va.
Arthur Perkins Jenks,	E.E.,	Philadelphia.
Harry Sackett Johnson,	E.E.,	East Aurora, N. Y.
Duncan Kennedy, jr.,	E.E.,	Washington, D. C.
Lawrence Rust Lee,	M.E.,	Shepherdstown, W. Va.
Charles Victor Livingston,	E.E.,	Kingston, N. Y.
Arthur Frost Loomis,	E.E.,	Oneida, N. Y.
Owen Gray MacKnight,	E.E.,	Plains.
Barry MacNutt,	E.E.,	Bethlehem.
William Adams Megraw,	M.E.,	Baltimore, Md.
Esteban Angel Mercenario,	C.E.,	Pueblo, Mex.
Thaddeus Merriman,	C.E.,	South Bethlehem.
Frank Douglass Mount,	C.E.,	Manasquan, N. J.
Carl Pivany Nachod,	E.E.,	Glenside.
Henry H. Newton,	M.E.,	Guadalajara, Mexico.
Robert Collyer Noerr,	C.E.,	Washington, D. C.
Harry Richards Peck,	M.E.,	Scranton.
John O'Reilly,	A. C.,	South Bethlehem.
James Harkins Pennington,	M.E.,	Philadelphia.
Morris Havens Putnam,	M.E.,	Tioga.
John Peake Reynolds, jr.,	M.E.,	Charleston, S. C.
Robert Porterfield Richardson,	A. C.,	Easton.
Samuel Stewart Riegel,	M.E.,	South Bethlehem.
Eugene Peronnean Roundey,	C.E.,	East Orange, N. J.
Woodford Royce,	M.E.,	Willimantic, Conn.
Auguste Leopold Saltzman,	M.E.,	Plainfield, N. J.

	COURSE.	RESIDENCE.
Charles Fred. Sanders,	C.E.,	Kutztown.
Charles Francis Scott,	E.E.,	New York City.
Henry Hamilton Seabrook,	E.E.,	Beaufort, S. C.
Samuel Palmer Senior,	C.E.,	Washington, D.C.
Arthur Harold Serrell,	E.E.,	Plainfield, N. J.
Frank Bradley Sheaffer,	C.E.,	New Bethlehem.
John Leefe Sheppard, jr.,	M.E.,	Charleston, S. C.
Edward Peter Shuman,	C.E.,	Allentown.
Jonathan Edward Slade,	C.E.,	Chicago, Ill.
Michael Thomas Stack,	C.E.,	Shenandoah.
Alvin Riegel Sterner,	E.E.,	Bethlehem.
Paul Beno Straub,	E.E.,	Pittsburg.
John Williams Thomas,	E.E.,	Hokendauqua.
Thomas Cedwyn Thomas,	E.M.,	Wilkes-Barre.
Columbus William Thorn,	C.E.,	Washington, D.C.
Wallace Treichler,	C.E.,	Elizabethtown.
Harry Carpenter Tschudy,	C.E.,	Smyrna, Del.
William Edward Underwood,	M.E.,	Lancaster.
Harrison Ricord VanDuyne,	E.E.,	Newark, N. J.
Charles Parker Wagoner,	C.E.,	Phoenixville.
Edward Hileman Waring,	M.E.,	Plainfield, N. J.
Gilbert Case White,	C.E.,	Richmond, Va.
Warren Worthington,	M.E.,	Rush Valley.
George Livingston Yates,	E.E.,	Carlisle.
Ambrose Everett Yohn,	M.E.,	Saxton.
Frank Steinmetz Young,	E.M.,	Plymouth Meeting.

## SOPHOMORE CLASS.

	COURSE.	RESIDENCE.
Harry Leigh Adams,	C.E.,	Washington, D.C.
Llewellyn H. Allport,	C.E.,	Philipsburg.
Thomas Johns Anderson,	M.E.,	Cumberland, Md.
Alanson Quigley Bailey,	Clas.,	Paterson, N. J.
Junius Ballard,	E.E.,	South Bethlehem.
Alejandro Barrientos,	C.E.,	Santiago de Cuba.
Richard Charles Becerra, jr.,	A.C.,	Caracas, Venezuela.

	COURSE.	RESIDENCE.
Arthur Knode Birch,	E.E.,	Washington, D. C.
Henry David Bishop,	M.E.,	Bethlehem.
Henry Theodore Borhek,	E.M.,	Bethlehem.
Frank Austin Boyer,	E.M.,	Pine Grove.
Horatio Francis Brown,	M.E.,	Baltimore, Md.
Paul Bucher,	E.E.,	Lebanon.
David F. Castilla,	M.E.,	Coahuila, Mex.
Greenleaf Howe Chasmar,	E.E.,	Brooklyn, N. Y.
David Hope Childs,	E.M.,	Towanda.
Benjamin Cooper Corbett,	Arch.,	New York City.
Herbert Myron Daggett,	E.E.,	Elmira, N. Y.
George Davies,	M.E.,	Catasauqua.
William Adam Dehm,	C.E.,	New Britain, Conn.
John Jacob Eckfeldt,	M.E.,	Conshohocken.
Linden Erle Edgar,	M.E.,	Wilkes-Barre.
Edgar D. Edmonston,	E.E.,	Washington, D.C.
James Ralph Farwell,	C.E.,	Oswego, N. Y.
John Augustus Fisher,	E.M.,	Huntingdon.
Edgar Raymond Frisby,	C.E.,	Washington, D.C.
Willard Boyer Fuller,	M.E.,	Catasauqua.
Archibald S. Furtwangler,	E.M.,	Greensburg.
José Maria Garza Galán, jr.,	E.M.,	Saltillo, Mex.
Stuart John Gass,	E.E.,	Washington, D. C.
Robert Edward Lee George,	E.E.,	Ellicott City, Md.
William Gratz,	E.E.,	Carmel, N. J.
William Gummere,	A.C.,	South Bethlehem.
Frank Hammond Gunsolus,	C.E.,	Tipton, Iowa.
Oscar C. Hannum,	C.E.,	Philadelphia.
Wentworth Greene Hare,	M.E.,	Philadelphia.
John Dwight Hastings,	E.E.,	Christiana.
Raymond Hazel,	E.E.,	Cressona.
George Duncan Heisey,	E.M.,	Pittsburg.
Henry Bruner Hershey,	E.E.,	Columbia.
Herbert H. Hess,	E.E.,	Hellertown.
Edward Darling Hillman,	M.E.,	Wilkes-Barre.
Harold John Horn,	E.E.,	South Bethlehem.
Leonard Sherman Horner,	E.E.,	Marshall, Va.
Philip Hopkins Janney,	M.E.,	Darlington, Md

	COURSE.	RESIDENCE.
Spencer Jackson Johnson,	E.M.,	Chicago, Ill.
Edwin Herman Kiehl,	C.E.,	Lancaster.
Frank Norman Kneas,	C.E.,	Norristown.
Arthur Octavius Knight,	M.E.,	Washington, D.C.
Edward Steckel Knisely,	M.E.,	Bethlehem.
Basil George Kodjbanoff,	M.E.,	Monastir, Macedonia.
Lewis Daniel Kreidler,	A.C.,	Bath.
Lewis Harry Kunkle,	M.E.,	Greensburg.
Thomas H. Lawrence,	E.E.,	Danville.
George Craig Leidy,	E.E.,	Washington, D. C.
John Brown Lindsey, jr.,	C.E.,	Frankfort, Ky.
Clarence Albert Loomis,	C.E.,	Bethlehem.
Owen Francis Luckenbach,	M.E.,	Bethlehem.
Frederic Kennedy Lundy,	E.E.,	Williamsport.
George Kennedy McGunnegle,	A.C.,	Meadville.
Lee Holmes Marshall,	M.E.,	Pittsburg.
Sidney Burbank Merrill,	A.C.,	Cincinnati, O.
Charles Francis Moritz,	E.E.,	South Bethlehem.
Hugh Nevins,	C.E.,	Hokendauqua.
Charles G. Newton,	E.M.,	Guadalajara, Mex.
José Aristides de Obaldia,	C.E.,	Panama, Rep. Col.
Howard Charles Paddock,	C.E.,	East Berlin, Conn.
Frederick Allen Perley,	C.E.,	Williamsport.
Clarence Marion Pflueger,	A.C.,	Seidersville.
Carroll Winston Quarrier,	M.E.,	Charleston, W. Va.
Victor Clinton Records,	C.E.,	Laurel, Del.
Percy Lawrence Reed,	C.E.,	New Bedford, Mass.
Benjamin DeWitt Riegel,	M.E.,	Riegelsville, N. J.
D'Arcy Wentworth Roper,	M.E.,	Petersburg, Va. .
Rafael Francisco Sanchez,	E.M.,	Gibara, Cuba.
Henry Cord Schwecke,	E.E.,	Charleston, S. C.
Henry Harger Scovil,	M.E.,	Copenhagen, N. Y.
Daniel Franklin B. Shepp,	C.E.,	Tamaqua.
Charles Shimer,	M.E.,	West Bethlehem.
Louis Soleliac, jr.,	E.E.,	Allentown.
Lewis Cheston Starkey,	M.E.,	Bustleton.
James Willis Stauffer,	Arch.,	South Bethlehem.
Martin Shaaff Stockett,	Clas.,	Pottsville.

	COURSE.	RESIDENCE.
Edmund Harrison Symington,	M.E.,	Baltimore, Md.
William Wharton Thurston,	E.M.,	South Bethlehem.
Richard Albert Turner,	C.E.,	Willimantic, Conn.
William F. Ulrich,	A.C.,	Bethlehem.
Charles Bartlett Warren,	M.E.,	Westfield, Mass.
Levi Watts, jr.,	E.E.,	Terre Hill.
Charles Edward Webster, jr.,	Clas.,	South Bethlehem.
David Sheibley Wert,	E.E.,	Carlisle.
Frederick Charles Wettlaufer,	A.C.,	New York City.
Howard Josephus Wiegner,	Arch.,	Bethlehem.
Theodore Benjamin Wood,	M.E.,	Chambersburg.
William Bell Wood,	M.E.,	Baltimore, Md.
Lawrence Wooden,	C.E.,	Hampstead, Md.
Samuel Augustus Yorks, jr.,	E.E.,	Danville.
Harry Statten Zimmerman,	C.E.,	State Line.

## FRESHMAN CLASS.

	COURSE.	RESIDENCE.
G. Fred Allen,	C.E.,	Florida, N. Y.
George Kriebel Anders,	E.E.,	Lansdale.
William Ernst Arrison,	E.E.,	Philadelphia.
Leon Whetstone Bailey,	E.E.,	Delano.
Clarence Barnard,	C.E.,	Washington, D.C.
Maurice Clark Benedict,	M.E.,	Altoona.
James Raymond Boak,	C.E.,	Hughesville.
Frank E. Bradenbaugh,	M.E.,	Parkersburg, W. Va.
John Morgan Buckland,	Sci.,	Hokendauqua.
Mahlon Brown Buckman, jr.,	M.E.,	Philadelphia.
José Fernando Capriles,	C.E.,	Puerto Cabello, Vene-
Charles Ford Carman,	C.E.,	Cedarville, N.J.[zuela.
Richard Francis Cleary,	E.E.,	Mahanoy City.
Bernard Todd Converse,	M.E.,	Louisville, Ky.
John Peter Croll,	C.E.,	Trexlerstown.
Rudolph Degener,	E.E.,	New York City.
Joseph Ellenbogen,	L.S.,	Allentown.
James Chickering England,	E.E.,	Washington, N. J.
John Erwin,	M.E.,	West Bethlehem.



	COURSE.	RESIDENCE.
George Cooper Fairchild,	C. E.,	Oswego, N. Y.
Robert Farnham, jr.,	C. E.,	Washington, D. C.
Herbert William Fitzgerald,	C. E.,	Columbia.
Theodore Frederic Forbes,	A. C.,	Fort McPherson, Ga.
Grier Foresman,	A. C.,	Williamsport. [to Rico.
José Gervasio Gandia,	C. E.,	Puerta di Tierra, Por-
J. Walter Gannon,	C. E.,	New Brighton, S. I.
James Henry Gledhill,	M. E.,	Riegelsville.
Eugene Gifford Grace,	E. E.,	Goshen, N. J.
John Wesley Grace, jr.,	E. E.,	Goshen, N. J.
Arthur Bradley Hanscom,	M. E.,	Philadelphia.
Richard Allan Harris,	E. E.,	East Northfield, Mass.
Ernest Warfel Haverstick,	E. E.,	Lancaster.
Paul Gerhard Ludiger Hilken,	M. E.,	Baltimore, Md.
James Cuthbert Holderness,	E. E.,	Cambridge, Mass.
George Augustus Horne,	A. C.,	Plainfield, N. J.
Roy Rhodes Hornor,	E. M.,	Parkersburg, W. Va.
George Reifsnyder Jackson,	C. E.,	Scranton.
Harry Reese James,	M. E.,	Braddock.
William Edward Johnston,	E. M.,	Latrobe.
Russell Kimball,	M. E.,	New York City.
Arthur Warner Klein,	M. E.,	Bethlehem.
Harry Edward Knight,	Sci.,	New York City.
Richard Skerrett Landron,	C. E.,	Puerta de Tierra, Por-
Newton Wambold Leidy,	E. E.,	W. Bethlehem. [to Rico
Leroy Streeper Leopold,	M. E.,	Pottstown.
Joseph William Linton,	E. E.,	Baltimore, Md.
Garth Bainbridge Luten,	C. E.,	Cayce, Ky.
Harry Packer Lynn,	Arch.,	Freemansburg.
Charles Michael Masson,	M. E.,	Hammondsport, N. Y.
Charles Pease Matheson,	C. E.,	Middletown.
William Lathrop Meaker,	A. C.,	Bethlehem.
James Flanders Middledith,	M. E.,	Plainfield, N. J.
Robert Hopkins Moffitt, jr.,	E. M.,	Harrisburg.
J. Foster Morgan,	E. E.,	Harwood Mines.
Elmer Fellman Musselman,	M. E.,	Middletown.
Frank Jacob Myers,	C. E.,	Bethlehem.

	COURSE.	RESIDENCE.
Charles Frederic Napier, jr.,	C.E.,	Asbury Park, N. J.
Charles Souders Padget,	Arch.,	Bethlehem.
Henry Ralph Palmer,	M.E.,	West Chester.
John Read Pettit,	E.M.,	Philadelphia.
William Piez,	M.E.,	Philadelphia.
Louis Thomas Rainey,	E.E.,	Decatur, Ill.
James Burr Reddig,	M.E.,	Shippensburg.
Percy Lesley Reed,	C.E.,	Sunbury.
Victor Hugo Reid,	E.M.,	Brooklyn.
Samuel Worman Ricker,	A.C.,	Easton.
Howard Albert Riegel,	C.E.,	Bethlehem.
Gustavo Rovelo,	M.E.,	Comitan-Chiapas, Mex
Oliverio Sanchez,	C.E.,	Nuevitas, Cuba.
Abraham Shimer,	M.E.,	West Bethlehem.
Robert Sargent Shriver,	Arch.,	Cumberland, Md.
Antes Latrobe Snyder,	C.E.,	Blairsville.
William Harold Speirs,	E.E.,	Bethlehem.
Abram Peters Steckel,	E.E.,	Lykens.
Robert Witmer Sterrett,	E.E.,	Milroy.
Robert Maximilian Straub,	C.E.,	Pittsburg.
Laurens Van Benthem,	E.E.,	The Hague, Holland.
John Sage Viehe,	E.E.,	Los Angeles, Cal.
Theodore Cuyler Visscher,	C.E.,	Rome, N. Y.
Joseph D. Wentling,	C.E.,	Greensburg.
Harry Packer Wilbur,	E.E.,	South Bethlehem.
Harry Anderson Wilcox,	E.E.,	West Granby, Conn.
George Bassett Williams,	Arch.,	Washington, D. C.
George Herbert Wood,	M.E.,	Chambersburg.
Edward Abraham Yellis,	C.E.,	Weaversville.
Wright Youtsey,	E.M.,	Newport, Ky.

## SPECIAL STUDENTS.

	COURSE.	RESIDENCE.
Frederick Hutton Getman,	A.C.,	Stamford, Conn.
William Lindley Pettit, jr.,	C.E.,	Fort Wayne, Ind.
Francis Betts Smith,	M.E.,	Hartford, Conn.
Brigham Smoot,	A.C.,	Provo City, Utah.
John Stewart, jr.,	E.M.,	Lonaconing, Md.
Harry Wellington Thatcher,	A.C.,	South Bethlehem.

## SUMMARY OF STUDENTS BY STATES.

Vermont, - - - - -	1
*Massachusetts, - - - - -	6
Rhode Island, - - - - -	2
Connecticut, - - - - -	11
New York, - - - - -	34
New Jersey, - - - - -	25
Pennsylvania, - - - - -	219
Delaware, - - - - -	2
Maryland, - - - - -	24
District of Columbia, - - - - -	20
Virginia, - - - - -	6
West Virginia, - - - - -	6
South Carolina, - - - - -	5
Georgia, - - - - -	2
Florida, - - - - -	1
Mississippi, - - - - -	2
Kentucky, - - - - -	4
Tennessee, - - - - -	2
Ohio, - - - - -	4
Indiana, - - - - -	3
Illinois, - - - - -	6
Michigan, - - - - -	1
Minnesota, - - - - -	2
Iowa, - - - - -	4
Utah, - - - - -	1

California,	-	-	-	-	-	-	-	-	-	-	1
Mexico,	-	-	-	-	-	-	-	-	-	-	8
Cuba,	-	-	-	-	-	-	-	-	-	-	4
Jamaica,	-	-	-	-	-	-	-	-	-	-	1
Porto Rico,	-	-	-	-	-	-	-	-	-	-	2
Costa Rica,	-	-	-	-	-	-	-	-	-	-	1
Republic of Colombia,	-	-	-	-	-	-	-	-	-	-	1
Venezuela,	-	-	-	-	-	-	-	-	-	-	2
Holland,	-	-	-	-	-	-	-	-	-	-	1
Macedonia,	-	-	-	-	-	-	-	-	-	-	1

## SUMMARY OF STUDENTS BY CLASSES AND COURSES.

	GRADUATES.	SENIORS.	JUNIORS.	SOPHOMORES.	FRESHMEN.	SPECIALS.	TOTALS.
Classical,	8	4	—	3	—	—	15
Latin-Scientific,	—	—	—	—	1	—	1
Science and Letters,	1	1	—	—	2	—	4
Civil Engineering,	4	31	22	22	25	1	105
Mechanical Eng.,	2	26	26	27	21	1	103
Mining Eng.,	8	11	6	11	6	1	43
Electrical Eng.,	2	26	29	24	22	—	103
Analytical Chem.,	3	5	5	8	5	—	26
Architecture,	1	4	—	3	4	3	15
Totals,	29	108	88	98	86	6	415

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